Assembly and Operating Instructions of British Railways Standard Class 9F

ACCUCRAFT TRAINS

ASTER HOBBY

Index

General Information of Prototype

The British Railways Class 9F 2-10-0 tender locomotives was regarded as probably the best designed and most successful of the 12 classes of standard locomotives introduced after the nationalisation of Britain's railways in 1948. No fewer than 251 of the Class 9F were built, the first appearing in 1954 and the very last - "Evening Star" in 1960.

The primary role of the Class 9F was heavy freight haulage and they are fondly remembered all over the UK with their long trains of mineral wagons. Often in filthy condition and leaking steam from every joint, these majestic locomotives with their flangeless centre driving wheels were a splendid spectacle for everyone who loved steam trains. However, the 9F class of locomotives also found favour on passenger trains. They are particularly associated in the memories of many enthusiasts for their excellent service on the steep gradients of the Somerset and Dorset line with heavy holiday traffic on trains like 'The Pines Express'. At the time that regular use of Class 9F locomotives on other express passenger services was curtailed, speeds up to 90mph were recorded!

Very few variations and modifications were made to the Class 9F during their very short lives. Just 10 (92020-92029) were built with Franco-Crosti boilers. But this complex boiler was not a success and all were subsequently removed and standard boilers fitted. The one modification which did deliver a noticeable benefit was the fitting of all 9Fs from No. 92178 in 1957 onwards with double blast pipes and chimneys. This allowed the engines to steam slightly more freely and thus generate a higher power output. Several of the earlier single chimney versions were retro-fitted with double chimneys. The other variation worth noting was the different types of tenders used with this class. Aster has chosen the BR 1G tender but other types were used depending upon regional conditions.

As already mentioned, in 1960 No. 92220 "Evening Star" became the very last steam locomotive to be built for British Railways. The famous ex-Great Western Railway workshops at Swindon were entrusted with this task. To mark this poignant occasion, she was named and finished in lined green passenger livery; a copper-capped chimney and polished copper and brass fixtures and fittings were given particular treatment. Evening Star was always treated as something of a celebrity engine and was frequently used for enthusiast railtours as the end of steam traction on the railways of Britain became a reality.

Evening Star's status as the last steam locomotive to be built by BR ensured her preservation and on withdrawal in 1965 she was placed in the National collection. She can be admired today at the National Railway Museum in York.

Evening Star was not the only 9F to be preserved. As many as nine locomotives of this class are restored or in the process of being restored. No. 92203 was purchased directly from BR by the celebrated railway and wildlife artist – Mr. David Shepherd and named by him "Black Prince". This locomotive has the distinction of having set the record for the heaviest train ever hauled by a steam locomotive in Britain, when it started a 2,162-ton train at a quarry in Somerset. Other notable restored examples include No. 92214 preserved at the Midland Railway Centre, Butterley. The 9F Locomotive Charitable Trust who own this locomotive have an excellent website at www.92214.co.uk. Their help and the help of the National Railway Museum are acknowledged with thanks in the design of the Aster model.

Aster Hobby and Accucraft Trains are proud to present to you the British Railways Standard Class 9F as our first joint collaboration model. We hope that it brings years of joy and admiration.

All support requests, such as technical advice and replacement parts, should be directed to the following:
English: sales4@asterhobby.co.jp
Japanese: info@asterhobby.co.jp

Specifications of British Railways Standard Class 9F

Gauge	1/32 Gauge One
Total Length (Buffer to Buffer)	640 mm
	(Locomotive 398 mm + Draw Bar 16 mm + Tender 226 mm)
Width	87.2 mm
Height	125 mm
Weight	4.1 kg (Locomotive) including 158g of weight
	1.37 kg (Tender)
Cylinders	2 Cylinders with Piston Valves
	Drain Valves
	Bore ϕ 13 mm × Stroke 22 mm
	Piston Valve stroke 6 mm × 6 mm
	Steam Port ϕ 2 mm × 6
Valve Gear	Walchaert, Valve travel 6 mm, Cut off 75% (full gear)
Wheel Arrangement	2-10-0
Main Driving Wheel	ϕ 46.8 mm
Leading Truck Wheel	ϕ 28 mm
Tender Wheel	ϕ 31 mm
Lubricator	Roscoe Displacement Type
Axle Driven Pump	Bore 5 mm × Ram Stroke 5.6 mm
Boiler	C type with ϕ 8 mm water tube
Boiler Capacity	Water 255 cc at 80% full
Normal Working Pressure	3-4 kg/sq.cm
Burner	3 Tubes Alcohol Burner
Controlling Features and Other Devices	Regulator Valve, Blower Valve, Reverser Handle, Drain Valve Handle, By-pass Valve, 2×Safety Valves, Blow-down valve, Water Gauge, Pressure Gauge, and Super heater
Tender	Hand pump mounted
	Removable alcohol tank
	Alcohol Tank capacity 180 cc
	Water Tank capacity 250cc
	Methylated alcohol
Minimum Radius	2 m

General Assembly and Operating Notes

This assembly and operating instruction booklet shows you how to assemble and operate your Aster Gauge One Live Steam, British Railways Standard Class 9F. It is recommended for the owners to read carefully this booklet with the Assembly Illustration in order to get familiar with the assembling and operating procedure in advance.

The assembly should be accomplished section by section in accordance with this booklet of Assembly and Operating Instructions and the Assembly Illustrations. Strictly follow the instructions during assembly.

Take notice of ➪ sign which frequently appears in the Assembly Illustrations. This sign indicates the points which you should apply packing compound to. Packing Compound is required to seal the joints. Properly applied compound prevents possible leakage of steam and water form the joints. Make sure no excess compound interferes with the smooth motion of moving parts and clog the inner bore of pipes and bolts.

Be careful not to damage or lose any of the components and hardware supplied. It is recommended to locate parts and hardware necessary for the section you are going to assemble in advance, referring to the Parts, Hardware and Supplies List in this booklet.

The tools and supplies supplied in the kit are as follows;

Screwdrivers for cross head
“L” hex wrenches for set screws
Injection syringe with nozzle
Packing compound
Ceramic Sheet
Sandpaper

In addition to the above tools, the following tools and supplies are required.

Needle nose pliers
Tweezers
Ruler or scale (1mm = 0.0394 in.)
Screwdrivers
A sheet of plate glass
Test Roller
Scissors
Air Compressor Source
Light Machine Oil
Fine files
Small hammer

If you wish to use the thread locker on threaded fasters of running gear, the adequate

amount of low strength thread locker such as Loctite 222 is suitable. It is important to choose the low strength thread locker which enables easily disassembly with hand tools without shearing the screws. Careful use of the proper amount of epoxy adhesive to attach detail fittings in place is necessary in case you wish to use it.

Allow yourself adequate time to complete each section. Do not become discouraged if you should face a problem. Keep in mind that assembling a live steam kit always requires your patience. You will harvest the fruits in efforts involved in assembling your kit with patience and care when your locomotive shows its beautiful appearance and reliable performance to you. Do not try to solve a problem by force. Patience and care is precious tool for a skilled model engineer.

Operation of a Gauge One live steam locomotive is identical to that of a real steam locomotive. This model is manually operated using the controlling devices in the cab. Before starting the operation, the owner should read this booklet for operating instructions carefully to get familiar with the operational procedure of this locomotive. Well understanding of the function of each basic feature and the controlling devices is indispensable to achieve the best performance in a safe way.

The tools required for operation are as listed below. They are not provided in kit. Refer to the Operating Instructions in this booklet.

Suction Fan
Methyl Alcohol
Distilled Water
Gloves
Steam Cylinder Oil

Maintenance is also indispensable to achieve safe and reliable performance and to maintain beautiful appearance of your locomotive. Frequently check the condition of your locomotive, referring to the maintenance instructions in this booklet.

It is the greatest pleasure of Aster Hobby and Accucraft Trains to offer you with the most fascinating live steam locomotive kit to evoke your engineering skills. We are here to give you any help we could so that you would fully enjoy yourself in the world of live steam locomotive by assembling and operating your locomotive.

Parts List

PART NO .& NAME		QUANTITY PER SECTION																									
		1	2	3	4	5	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1. ASSEMBLY OF MAIN FRAME AND CYLINDER																											
1	Drain Valve Piston	2																									
2	Front Cylinder Cover	2																									
3	Cylinder Block	2																									
4	Crosshead L.H.	1																									
5	Crosshead R.H.	1																									
6	Cylinder Rear Cover	2																									
7	Cylinder Gasket	4																									
8	Piston	2																									
9	Slide Bar Bracket R.H.	1																									
10	Slide Bar Bracket L.H.	1																									
11	Boiler Support	1																									
12	Main Frame L.H.	1																									
13	Crossbar	1																									
14	Main Frame R.H.	1																									
15	Drain Valve Arm	1																									
16	Drain Valve Lifting Arm	2																									
17	Activation Rod	1																									
18	Drain Valve Shaft	1																									
19	Crosstie	1																									
20	Axle Driven Pump Holder	1																									
21	Drain Valve Handle	2																									
22	Drain Valve Shaft	1																									
23	Crosstie	1																									
24	Brace	2																									
25	Cabin Floor	1																									
26	Cabin Foot Plate Support	1																									
27	Drawbar	1																									
28	Bearing	1						1																			
29	Slide Bar	2																									
30	Slide Bar Spacer	2																									
31	Slide Bar Bottom	2																									
32	Pilot Truck Bracket	1																									
33	Pilot Truck Radius Fulcram	1																									
34	Stopper for Drain Valve Handle	2																									
2. ASSEMBLY AND INSTALLATION OF DRIVING WHEELS																											
1	1st Coupled Driving Wheels		1																								
2	Counter Balance Outside		8																								
3	Counter Balance Inside		8																								
4	Main Coupled Driving Wheels		1																								
5	Counter Balance for 3rd Driver		2																								
6	Counter Balance for 3rd Driver		2																								
7	Reverser Lever		1																								
8	Reverser Holder		1																								
9	Collar		1																								
10	Reversing Screw		1																								
11	Reversing Handle		1																								
12	Collar		1																								
13	Reversing Roller		1																								
14	Collar		1																								
15	Pin		1	1																							
16	Steel Waight		2																								
17	Spring		10																								
18	4th and 5th Coupled Driving Wheels		2																								
19	Retainer		8																								
20	Retainer for 3rd Driver		2																								
21	2nd Coupled Driving Wheels		1																								
22	Dummy Brake Shaft Bearing		2																								
23	Oil Distributor L.H.		1																								
24	Oil Distributor R.H.		1																								

PART NO .& NAME		QUANTITY PER SECTION																										
		1	2	3	4	5	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
25	Oil Distributor		2																								
26	Dummy Brake L.H.		4																								
27	Dummy Brake R.H.		4																								
28	Dummy Brake L.H.		1																								
29	Dummy Brake R.H.		1																								
30	Dummy Sander Nozzle L.H.		1																								
31	Dummy Sander Nozzle R.H.		1																								
32	Brake Beam		3																								
33	Dummy Sander Nozzle		2																								
34	Dummy Sander Nozzle		2																								
3. ASSEMBLY OF AXLE DRIVEN PUMP DEVICE																											
1	Axle Driven Pump Ram			1																							
2	Axle Driven Pump Body			1																							
3	By-pass Valve Bracket			1																							
4	By-pass / Check Valve Body			1																							
5	By-pass Valve Needle			1																							
6	By-pass Valve Handle			1																							
7	Screw			1																							
8	Water Pipe to the Boiler			1																							
9	Water Pipe from the Tender			1																							
10	Banjo Bolt			2			4					1				1											
11	Teflon Yarn			1																							
12	Eccentric Strap			1																							
13	Eccentric Strap			1																							
14	Axle Driven Pump Rod			1																							
4. INSTALLATION OF SIDE RODS																											
1	Radius Rod				2																						
2	Expansion Link Pivot Inside				2																						
3	Spacer				2																						
4	Expansion Link				2																						
5	Die Block				2																						
6	Spacer				2																						
7	Expansion Link Pivot Outside				2																						
8	Pin				2																						
9	Reverser Link				2																						
10	Pin				4																						
11	Reversing Arm R.H.				1																						
12	Expansion Link Support R.H.				1																						
13	Reversing Rod Guide				1																						
14	Reverser Shaft				1																						
15	Expansion Link Support L.H.				1																						
16	Reversing Shaft Lever L.H.				1																						
17	Coupling Rod L.H.				1																						
18	Coupling Rod R.H.				1																						
19	Washer				6																						
19c	Countersunk Washer				2																						
20	Main Rod L.H.				1																						
21	Main Rod R.H.				1																						
22	Crosshead Screw				2																						
23	Bearing				2																						
5. ASSEMBLY OF PISTON VALVE DEVICE AND REVERSING GEAR DEVICE																											
1	Return Crank(R)					1																					
2	Return Crank(L)					1																					
3	Steam Distribution Block L.H.					1																					
4	Steam Distribution Block R.H.					1																					
5	Steam Chest					2																					
6	Piston Valve Spindle					2																					
7	ForkEnd					2																					
8	Piston Valve					2																					
9	Reverser Fork End					1																					
10	Reversing Rod					1																					
11	Reverser Block					1																					
12	Union Link					2																					
13	Combination Lever					2																					
14	Exhaust Block					1																					
15	Eccentric Rod					2																					
16	Crank Pin					2																					
17	Pin					9																					
18	Pin					3																					

	PART NO .& NAME	QUANTITY PER SECTION																										
		1	2	3	4	5	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
7. AIR TEST																												
1	Nut						1																					
2	Steam Pipe						2																					
8. ASSEMBLY AND INSTALLATION OF PILOT TRUCK AND OIL TANK																												
1	Pilot Truck Frame							1																				
2	Guard Iron							1																				
3	Pilot Truck Wheels							1																				
4	Spring							2																				
5	Pilot Truck Shaft							1																				
6	Pilot Truck Wheel Holder							1																				
7	Oil Tank Holder							1																				
8	Oil Tank Cap							1																				
9	Oil Tank Band Iron							1																				
10	Oil Tank							1																				
11	Pilot Truck Spring							1																				
12	Spring							2																				
	TT-Φ3(Teflon tube)							1																				
9. INSTALLATION OF CYLINDER COVER AND OTHER COMPONENTS																												
1	Drain Valve Nozzle L.H.								1																			
2	Drain Valve Nozzle R.H.								1																			
3	Cylinder Tail Cover R.H.								1																			
4	Cylinder Tail Cover L.H.								1																			
5	Cylinder Front Panel								2																			
6	Spindle Guide L.H.								1																			
7	Spindle Guide R.H.								1																			
8	Dummy Snifting Valve								2																			
9	Cylinder Cover L.H.								1																			
10	Cylinder Cover R.H.								1																			
11	Dummy Drain Valve L.H.								1																			
12	Dummy Drain Valve R.H.								1																			
13	Dummy Lubricator Lever L.H.								1																			
14	Dummy Lubricator Lever R.H.								1																			
15	Dummy Lubricator								2																			
16	Dummy Lubricator Crank								2																			
17	Dummy Lubricator Link								2																			
18	Smoke Box Saddle								1																			
10. ASSEMBLY OF FRONT BUFFER FITTINGS																												
1	Bufffer Head									2															2			
2	Hook Coupler									1															1			
3	Front Deck									1																		
4	Buffer Shank									2															2			
5	Buffer Stock Bolt									2															2			
6	Coupler Spring									1															1			
7	Front Buffer Beam									1																		
8	Buffer Beam Plate									1																		
9	Buffer Spring									2															2			
10	Buffer Stock									2															2			
11	Front Step									2																		
12	Front Deck L.H.									1																		
13	Front Deck R.H.									1																		
14	Lamp Iron									3																		
15	Works Plate									2																		
17	Front Step L.H.									1																		
18	Front Step R.H.									1																		
19	Dummy Hose									1															1			
11. ASSEMBLY OF IINER BOILER (1)																												
1	Fire Box										1																	
2	Cabin Back Head										1																	
3	Regulator Valve Handle										1																	
4	Blower Valve Handle										1																	
5	Blower Valve Needle										1																	
6	Blower Valve Body										1																	
7	Regulator Valve Needle										1																	
8	Regulator Body										1																	
9	Inner Boiler										1																	

PART NO .& NAME		QUANTITY PER SECTION																										
		1	2	3	4	5	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
12. ASSEMBLY OF INNER BOILER (2)																												
1	Water Gauge Glass											1																
2	Gauge Glass Holder											1																
3	Gauge Glass Holder Cap											1																
4	Steam Pipe											1																
5	Water Pipe											1																
6	Banjo Bolt											1																
7	Blow-Down valve Body											1																
8	Needle Valve											1																
9	Siphone Tube for Pressure Gauge											1																
10	Steam Inlet											1																
11	Miura joint											1																
13. ASSEMBLY OF BOILER CASING																												
1																												
2	Handrail Stanchion												10			2			6				8					
3	Boiler Casing												1															
4	Dummy Washout Plug												2															
5	Side Step												2															
6	Dummy Blow-Off Cock												2															
7	Dummy Washout Plug												1															
8	Dummy Regulator Lever												1															
9	Dummy Washout Plug												1															
10	Dummy Regulator Valve												1															
11	Dummy Check Valve L.H.												1															
12	Dummy Check Valve R.H.												1															
14. INSTALLATION OF INNER BOILER TO BOILER CASING																												
1	Boiler Ring													1														
15. INSTALLATION OF SUPER HEATER AND OTHER COMPONENTS																												
1	Superheater														1													
2	Banjo Bolt														1													
3	Exhaust Nozzle														1													
4	Banjo Bolt														1													
5	Plug														1													
6	Steam Dome														1													
7	Safety Valve Cover														1													
8	Safety Valve														2													
9	Dummy Manifold														1													
10	Fire Box Front														1													
11	Fire Box Casing L.H.														1													
12	Fire Box Casing R.H.														1													
13	Weight														2													
16. MOUNTING THE BOILER ASSEMBLY																												
1	Smoke stack base															1												
2	Smoke Box															1												
3	Chimney saddle															1												
4	Chimney															1												
5	Water Pipe															1												
6	Banjo Bolt															1												
7	Petticoat															1												
17. ASSEMBLY AND INSTALLATION OF CABIN																												
1	Reach Rod Guide																1											
2	Window Frame L.H.																1											
3	Window Frame R.H.																1											
4	Cabin																1											
5	Glass																2											
6	Sash L.H.																1											
7	Sash R.H.																1											
8	Gutter L.H.																1											
9	Gutter R.H.																1											
10	Windshield Frame																2											
11	Glass																2											
12	Cab Roof Support																2											
13	Cab Roof																1											
14	Ventilator																2											

PART NO .& NAME		QUANTITY PER SECTION																										
		1	2	3	4	5	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
18. INSTALLATION OF RUNNING BOARD AND FITTINGS																												
1	Smoke Deflector Support																	2										
2	Smoke Box Shed Plate(18A)																	1										
3																												
4	Smoke Box Door Handle																	2										
5	Loco Number Plate 92059																	1										
6																												
7	Smoke Box Front																	1										
8	Running Board R.H.																	1										
9	Sand Filler																	3										
10	Link																	1										
11	Dummy Weight Shaft																	1										
12	Injector Pipe End Holder																	1										
13	Running Board L.H.																	1										
14																												
15																												
19. INSTALLATION OF SMOKE DEFLECTORS AND OTHER COMPONENTS																												
1	Smoke Deflector Support L.H.																		1									
2	Smoke Deflector Support R.H.																		1									
3	Smoke Deflector L.H.																		1									
4	Smoke Deflector R.H.																		1									
5	Steam Pipe Cover																		2									
6	Front Ladder L.H.																		1									
7	Front Ladder R.H.																		1									
8	Smoke Deflector Support																		2									
9	Dummy Piping (copper pipe Φ2)																		2									
10	Control Valve																		1									
11	Piping Cover																		1									
12	Dummy Ejector																		1									
13	Cabin Plate																		1									
20. INSTALLATION OF DETAIL FITTINGS																												
1	Reverser Cover																			1								
2	Dummy Reach Rod																			1								
3	Regulator Guide																			1								
4																												
5																												
21. INSTALLATION OF BURNER																												
1	Burner Holder																				2							
2	Burner																				1							
3	Control Valve																				1							
4	Dummy Injector																				1							
5	Dummy Box																				1							
22. ASSEMBLY OF TENDER (1)																												
1	Tender Frame																					1						
2	Tender Front Beam																					1						
3	Dummy Brake Shaft Bearing L.H.																					1						
4	Dummy Brake Shaft Bearing R.H.																					1						
5	Hand Pump Body																					1						
6	Cap																					1						
7	Suction Valve Seat																					1						
8	Pump Ram																					1						
9	Pump Link																					2						
10	Pump Lever																					1						
11	Cross Member																					2						
12	Ram Pin																					1						
13	Water Pipe																					1						
14	Water Return Pipe																					1						
15	Water Tank																					1						
16																												
17	Water and Fuel Tank Seat																					1						

	PART NO .& NAME	QUANTITY PER SECTION																								
		1	2	3	4	5	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
23. ASSEMBLY OF TENDER (2)																											
1	Tender Body																						1				
2	Access Door																						1				
3																											
4	Hand Grab																						2				
5	3 Lamps Iron																						1				
6	Lamp Iron																						1				
7	Hook																						2				
8	Hand Grab(S)																						1				
24. ASSEMBLY OF TENDER (3)																											
1	Dummy Sieve L.H.																							1			
2	Dummy Sieve R.H.																							1			
3	Water Delivery Pipe																							2			
4	Fuel Sump																							1			
5	Tender Wheels																							1	2		
6	Journal Box																							2	4		
7	Spring																							2	4		
8	Dummy Stay																							2			
9	Dummy Leaf Spring																							2	4		
25. ASSEMBLY OF TENDER (4)																											
1	Front Step																								2		
2	Rear Step L.H.																								1		
3	Rear Step R.H.																								1		
4	Rear Guard Iron L.H.																								1		
5	Rear Guard Iron R.H.																								1		
6	Rear Buffer Beam																								1		
7	Rear Buffer Beam Plate																								1		
8	Drawbar Pin																								1		
9	Drawbar Spring																								1		
10	Tender Front Deck																								1		
11	Dummy Water Pick Up and Hand Brake Handle																								2		
12	Dummy Water Pick Up and Hand Brake Handle																								2		
26. ASSEMBLY OF TENDER (5)																											
1																											
2																											
3																											
4	Hand Hold																									2	
5	Rear Step																									1	
6	Fuel Tank																									1	
7	Fuel Tank Valve Needle																									1	
8	Cap																									1	
9	Water Tank Cover																									1	
27. COUPLING THE LOCOMOTIVE AND TENDER																											
1	Tender Rear Plate（BR1C)																										1
2																											
3	Water Capacity Plate（4725）																										1
4	Pump Extension Handle																										1
5	Side Door Rear																										2
6	Door Belt																										2
7	Side Door																										2
8	Door Pin																										4
9	Pipe Union																										1
10	Union Nut																										1

DESCRIPTION		QUANTITY PER SECTION																										TOTAL
		1	2	3	4	5	6	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
Hexagonal Head Screw																												
H	M2-4	24	8																						4			36
	M2-6																	1										1
	M2-12		10																									10
	M3-6	4																										4
Flat Head Screw																												
B	M2-4(BS)																							2				2
	M2.6-6(BS)																					2						2
	M2.3-8					4																						4
Pan Head Screws																												
+	M1.2-3												9				2		18									29
	M1.4-3							2	2						4		10	4	2	2	1			4	8		4	43
	M1.7-4			2	7			4																				13
	M1.4-5		20																									20
	M1.4-6														1										2			3
	M1.7-3	4																										4
	M1.7-5	4																										4
	M2-2.5															11		5	5							2		23
	M2-4	26	19	2				14	21	14				7	5	2	4	14	6		9	2	6	10	10			171
	M2-5	4	1	4																								9
	M2-8								4						6													10
	M3-4(BS)					1																						1
	M2.6-4										3																	3
	M2.6-6	1	4					1								1												7
Countersunk Screws																												
C	M2-4	4	4																									8
	M2-4 (SUS)				4																							4
	M1.4-7				4																							4
Nuts																												
N	M3	1																										1
	M2		5			4										2			4		2							17
	M2.6		1																									1
	M2.6(BS)																					6						6
	M2(SUS)				4																							4
Set Screws																												
P	M2-2.5	7		1		2																						10
	M2.6-3			1	2						2																	5
E-Rings																												
E	φ3							1																	2			3
	φ4		1																									1
Spring Washer																												
SW	φ3	5																										5
Washer																												
W	φ2.6									1						1									1			3
	φ2							2																				2
	φ4							2																	1			3
Split Pin																												
SP	SP1								2	1															1			4
		1	2	3	4	5	6	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	TOTAL

Hardware List

Shaded hardware is packaged in pouch of respective section.

	DESCRIPTION	QUANTITY PER SECTION												
		1	3	5	8	11	12	15	16	21	22	26	27	TOTAL
PN3-1.9	φ3-1.9mm Neoprene O-ring											1		1
PN3.2-1	φ3.2-1mm Neoprene O-ring		1											1
PN4.5-1	φ4.5-1mm Neoprene O-ring		1											1
PN5-1.9	φ5-1.9mm Neoprene O-ring				1									1
PN6-1	φ6-1mm Neoprene O-ring						2							2
PN7-1.9	φ7-1.9mm Neoprene O-ring										1	1		2
PS3-1.9	φ3-1.9mm Sillicone O-ring			12		1		1						14
PS4-1.9	φ4-1.9mm Silicone O-ring							1						1
PF2-1.5	φ2-1.5mm Fluoride O-ring		1			1	1							3
PF3-1.9	φ3-1.9mm Fluoride O-ring	2												2
PF4-1.9	φ4-1.9 Fluoride O-ring					2								2
PF5-1.9	φ5-1.9 Fluoride O-ring							2						2
FG-5	φ5 Fibre Gasket										2			2
GP7	M7 Gland Nipple	2												2
GN5-2	M5 inner dia2.0mm Gland Nut				1									1
GN5-3	M5 inner dia 3.0mm Gland Nut						2							2
GN8-5	M8 inner dia 5.2mm Gland Nut		1											1
GN8-6B	M8 inner dia 6.2mm Gland Nut						2							2
LN5-7	M5 Lock Nut		2			1	2				2			7
LN8-10	M8 Lock Nut		1											1
LN10-12	M10 Lock Nut					1								1
SB-φ3	φ3mm Stainless Steel Ball		2						1					3
SB-φ4	φ4mm Stainless Steel Ball										2			2
PR-φ6	φ6mm Piston Ring			8										8
PR-φ13	φ13mm Piston Ring	4												4
PG-φ20	φ20mm Pressure Gauge						1							1
HC1	Fastener												3	3
BT-φ5	Fluoride Tube								○				○	185mm
ST-φ7	Silicone Tube												○	75mm
CY	Ceramic Yarn for burner wicks									○				

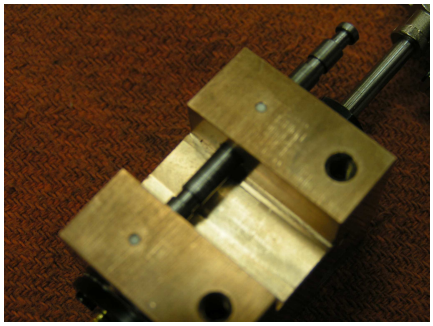
Assembly Instructions

1. ASSEMBLY OF MAIN FRAME AND CYLINDER

This section assembles the two cylinders and main frame. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

Pre-assembly notes;

Smooth motion of Piston Rods and slide bars is critical for the reliable performance of this engine. Frequently check the smooth motion of each moving part during assembly and patiently adjust relevant screws and components until the smooth motion is verified.



Block the smaller holes on the side of 1-3 Cylinder Block which will be contacting the main frame, using small amount of packing compound as shown with the illustration encircled with dotted line before starting assembly.

1. Assembly of Left Hand Cylinder

Assemble the left hand cylinder as shown with Fig.1 in the illustration.

1. Apply a very thin coat of packing compound (provided in kit) on both sides of 1-7 Cylinder Gaskets and attach them in place on 1-3 Cylinder Block. Attach 1-2 Front Cylinder Cover in place using H-M2-4 hex screws.
2. Inject a few drops of Light Machine Oil (not provided in kit) into the cylinder and insert 1-8 Piston after fitting PR13 Piston Rings over the piston grooves.
3. Slip 1-6 Cylinder Rear Cover, a PF3-1.9 O-ring and GP-7 Gland Nut over the piston rod. Press the O-ring into the 1-6 Cylinder Rear Cover fastening the GP-7 Gland Nut and fasten H-M2-4 hex screws diagonally to secure 1-6 Cylinder Rear Cover in

place. The bolts must be fastened evenly to ensure smooth motion of the rod. Slide the piston for several strokes to confirm it slides smoothly.

4. Insert 1-1 Drain Valve Piston into the hole on the front side of 1-3 Cylinder Block.

Repeat the same sequence and make Right Hand Side cylinder assembly.

2. Assembly of Main Frame

Assembly of the main frame should take place on a perfectly flat surface such as a plate glass or level block. Make sure to use correct frame of 1-12 Main Frame L.H. and 1-14 Main Frame R.H. referring to the orientation of counter sinking on each main frame. The counter sinking is shown with the sign of ★ in the illustration.

1. Attach 1-9 Slide Bar Bracket R.H, and 1-10 Slide Bar Bracket L.H. in place to 1-11 Boiler Support and fasten H-2-4 hex screws as shown with Fig. 4. Make sure to use correct piece of 1-9 Slide Bar Bracket R.H. and 1-10 Slide Bar Bracket L.H.
2. Install 1-11 Boiler Support in place to 1-12 Main Frame L.H. and 1-14 Main Frame R.H. and temporarily fasten M2-4 screws from the outside of main frames to secure the boiler support.
3. Install 1-19 Crosstie and 1-20 Axle Driven Pump Holder in place to 1-12 Main Frame L.H. and 1-14 Main Frame R.H. and temporarily fasten M2-4 screws from outside of the main frames. Install 1-23 Crosstie in place to the main frames and temporarily fasten M2-5 screws from right hand side of the main frame and M2-4 screws from left hand side of the main frame to secure 1-23 Crosstie. Make sure to use correct screws to secure 1-23 Crosstie. Verify that 1-12 Main Frame L.H, and 1-14 Main Frame R.H. are perfectly in phase and fully tighten M2-4 and M2-5 screws which have been temporarily fastened.
4. Insert 1-17 Activation Rod into the cutout of 1-11 Boiler Support and 1-19 Crosstie. Insert further the end of 1-17 Activation Rod to the clearance between 1-14 Main Frame R.H. and 1-20 Axle Driven Pump Holder.
5. Insert the pin of 1-15 Drain Valve Arm in place to the front hole of 1-17 Activation

Rod. Fit 1-16 Drain Valve Lifting Arm to the main frame for both sides, inserting 1-18 Drain Valve Shaft into the aligned holes of 1-15 Drain Valve Arm, main frame, and 1-16 Drain Valve Lifting Arm and temporarily fasten P-M2-2.5 set screws.

6. Insert the shorter pin of 1-21 Drain Valve Handle to the rear hole of 1-17 Activation Rod. Insert 1-22 Drain Valve Shaft into the hole of 1-21 Drain Valve Handle, fastening P-M2-2.5 set screws. Verify that both 1-21 Drain Valve Handles are in phase.
7. Fit 1-13 Crossbar in place to the inside of each main frame and fasten M2-5 screws from 1-11 Boiler Support to secure the crossbar.
8. Make assembly using the components in a square of dotted line in the illustration. Attach 1-26 Cabin Foot Plate Support to 1-25 Cabin Floor using M2-4 screws.
9. Install 1-27 Draw Bar in place to 1-25 Cabin Floor using 1-28 Bearing and M2.6-6 screw.
10. Install 1-25 Cabin Floor in place to the main frame fastening M2-4 screws from the outside of the main frame of both hand sides.
11. Fit 1-24 Brace for left hand side in place to 1-25 Cabin Floor using M2-4 screws. Temporarily fasten M2-4 screws to secure 1-24 Brace for right hand side. 1-24 Brace for right hand side will be detached when installing 3-4 By-pass Valve Body in section 3.
12. Fasten 1-33 Pilot Truck Radius Fulcrum into 1-32 Pilot Truck Bracket using SW-ϕ3 Spring Washer and N-M3 Nut as shown with Fig. 2. Install 1-32 Pilot Bracket to the main frame using C-M2-4 countersunk screws.

3. Installation of Cylinders

1. Attach 1-29 Slide Bar and 1-30 Slide Bar Spacer in place to 1-4 Crosshead L.H. and Crosshead R.H. Take note of correct orientation of 1-29 Slide Bar. Fit 1-31 Slide Bar Bottom in place to 1-4 Crosshead L.H. and 1-5 Crosshead R.H. and fasten M1.7-5 screws from underneath of 1-31 Slide Bar Bottom.
2. Firmly screw 1-4 Crosshead L.H. (1-5 for R.H.) to the thread of 1-8 Piston.
3. Install the assembled cylinders to the main frames using SW-ϕ3 Spring Washer

and H-M3-6 hex screws from inside of each main frame. Fit the fork end of 1-16 Drain Valve to the correct groove of 1-1 Drain Valve Piston. Fit 1-34 Stopper for Drain Valve Handle using P-M2-2.5 set screws in place to 1-21 Drain Valve Handle as shown with the illustration. Verify that both 1-16 Drain Valve Lifting Arms are in phase. Make sure to fully tighten P-M2-2.5 set screws which have been temporarily fastened at the position where the fork end of 1-16 Drain Valve Lifting Arms are contacting 1-3 Cylinder Block when the drain valve handle is set at OPEN position as shown with the left inset at the top of the illustration. Verify that 1-16 Drain Valve Lifting Arms are vertical to the track when the drain valve handle is set at SHUT position as shown with the right inset at the top of the illustration. Verify that the drain valve moves correctly when opening and closing the handle as shown with the inset in the illustration. The handle should keep closed position before testing the performance.

4. Fasten M1.7-3 screws from the holes on 1-9 Slide Bar Bracket R.H. and 1-10 Slide Bar Bracket L.H. to secure the slide bars.
5. Verify that smooth sliding motion is obtained as shown with Fig.3. If it is not obtained, check the correct orientation of 1-31 Slide Bar Bottom. If necessary, apply a drop of thread locker such as Loctite 222 to the threaded end of 1-8 Piston to secure crosshead after verifying the smooth sliding motion.

2. ASSEMBLY AND INSTALLATION OF DRIVING WHEELS

This section assembles and installs the driving wheels and reverse gear handle. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

1. Assembly and installation of Driving Wheels

Assemble the driving wheels as shown with the illustration.

1. Attach 2-2 Counter Balance Outside to the outside of 2-1 1st Coupled Driving Wheels, 2-21 2nd Coupled Driving Wheels, 2-18 4th and 5th Coupled Driving Wheels. The holes on the wheels indicated with the arrows in the photo below have some play. Verify that each counter balance is correctly positioned referring to the photo in the right. Attach 2-3 Counter Balance Inside to the inside of the above driving wheels and fasten M1.4-5 screws from 2-3 Counter Balance Inside as shown with Fig. 5. Take note of correct orientation of each counter balance. Make sure to use correct driving wheels paying attention to the shape of the pin of each driving wheel.

2. Attach 2-5 Counter Balance Outside for 3rd Driver to the outside of 2-4 Main Coupled Driving Wheels and attach 2-6 Counter Balance Inside for 3rd Driver to inside of 2-4 Main Coupled Driving Wheels fastening M1.4-5 screws as shown with

Fig. 6. Take note of the correct orientation of each counter balance.

3. Put 2-17 Spring into the axle boxes on every driving wheel.
4. Mount the driving wheels to the main frame in place.
5. Apply 2-19 Retainer to 1st, 2nd, 4th and 5th Driving Wheels using M2-4 screws. Apply 2-20 to 3rd Driving Wheel and fasten C-M2-4 countersunk screws, taking note of the correct orientation referring to the counter sinking on each retainer as shown with the photo below.

2. Assembly and Installation of Reverser Handle

1. Make the reverser handle unit using 2-7 Reverser Lever, 2-8 Reverser Holder, 2-9 Collar, 2-10 Reversing Screw, 2-11 Revering Handle, 2-12 Collar, 2-13 Reversing Roller, 2-14 Collar, 2-15 Pin, N-M2.6 Nut, N-M2 Nut, E-ϕ4 E-ring, and M2-5 screws as shown with Fig.7. The dimension of 2-15 Pin is as shown with the top left of the illustration.
2. Install the above unit of reverser handle to 1-25 Cabin Floor using M2-4 screws.
3. Insert the lugs of 2-22 Dummy Brake Shaft Bearing in place to the main frame and carefully bend them outward to secure 2-22 Dummy Brake Shaft Bearing.
4. Mount 2-16 Steel Weight in place to the main frame and fasten C-M2.6-6 countersunk screws from left hand side of the main frame.

The assembly of dummy brake devices and sander nozzles as shown with Fig.8 should take place in Section 3 after the installation of the axle driven pump device.

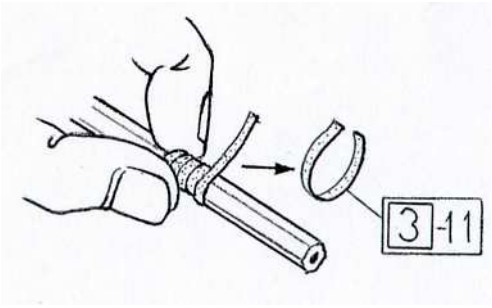
3. ASSEMBLY OF AXLE DRIVEN PUMP DEVICE

This section assembles axle driven pump device. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

1. Assembly of Axle Driven Pump Device

Assemble the axle pump device as shown with the illustration.

1. Refer to Fig.10. Fasten P-M2.6-3 set screw, setting the bearing of 2-21 2nd coupled Driver at the center of the axle. Roll 3-11 Teflon Strip around the groove of the bearing of 2-21 2nd Coupled Driver after rolling it around a pencil once for easier handling as shown below.



Apply a drop of light machine oil to 3-11 Teflon Strip as instructed with the sign in the illustration and install 3-12 Eccentric Strap and 3-13 Eccentric Strap around the bearing of 2-21 2nd Coupled Driver using M1.7-4 screws. Attach 3-14 Axle Driven Pump Rod to 3-13 Eccentric Strap and fasten M2-5 screws from 3-13 Eccentric Strap.

2. Refer to Fig.9. Put SB-ϕ3 stainless steel balls to the inside of 3-2 Axle Driven Pump Body. Fasten 3-7 Axle Driven Pump Screw to 3-2 Axle Pump Body, applying small amount of packing compound to the thread of 3-7 Axle Driven Pump Screw. Fit 3-2 Axle Driven Pump Body in place to 1-20 Axle Driven Pump Holder and fasten LN8-10 Lock Nut to the thread of 3-2 Axle Driven Pump Body.
3. Fit PN3.2-1 O-ring to the groove on 3-1 Axle Driven Pump Ram and insert it into 3-2 Axe Driven Pump Body, applying a drop of light machine oil as instructed with the sign in the illustration. Fasten GN8-5 Gland Nut, fitting PN4.5-1 O-ring in place.
4. Apply a thin coat of packing compound to the pipe of 3-9 Water Pipe from The Tender. Install 3-9 Water Pipe from The Tender to 3-2 Axle Pump Body, fastening 3-10a Axle Driven Pump Bolt and insert the thread of 3-9 Water Pipe from

The Tender in place to the hole of 1-25 Cabin Floor. Make sure no excess compound exudes from the joints and thus interferes with the motion of the valve balls. Use correct bolt to assure the reliable function of the device. The dimension of 3-10 Axle Driven Pump Bolts are as shown with the illustration. Fasten LN5-7 Lock Nut to secure 3-9 water pipe.

5. Detach 1-24 Brace for right hand side and M2-5 screws which have been fastened to secure 1-23 Crosstie and keep them in safe place.
6. Connect 3-8 Water Pipe to The Boiler with the threaded protrusion of 3-4 By-pass /Check Valve Body fastening a nut of 3-8 water pipe.
7. Insert the thread of 3-4 By-pass/Check Valve Body to the hole of 3-3 By-pass Valve Bracket and fasten LN5-7 Lock Nut.
8. Install the above assembly of 3-3 By-pass Valve Bracket, 3-4 By-pass/Check Valve Body and 3-8 Water Pipe in place, applying thin coat of packing compound to the pipe of 3-8 as instructed with the sign in the illustration. Fasten M2-4 screws into 3-3 By-pass Valve Bracket. Fasten M2-5 screws which have been detached in this section to fully secure 3-3 By-pass Valve Bracket. Install 1-24 Brace for right hand side which has been detached in this section using M2-4 screws.
9. Fasten 3-5 By-pass Valve Needle into the threaded hole of 3-4 By-pass/Check Valve after fitting PF2-1.5 O-ring over the groove of 3-5 By-pass Valve Needle. Fit the hole of 3-6 By-pass Valve Handle to the pin of 3-5 By-pass Valve Needle, fastening P-M2-2.5 set screw.
10. Connect the fork end of 3-1 Axle Driven Pump Ram with the end of 3-14 Axle Driven Pump Rod using 2-15 Pin.

2. Assembly of Dummy Brake Devices and Dummy Sander Nozzles

(See section 2)

1. Insert the pin of 2-28 Dummy Brake L.H. and 2-29 Dummy Brake R.H. into the main frame. Install 2-30 Dummy Sander Nozzle, 2-31 for R.H. and 2-32 Brake Beam to inside of the main frame and fasten H-M2-12 hex screw to the aligned holes as shown with Fig. 8.

2. Fit 2-26 Dummy Brake L.H. (2-27 for R.H.) for the second driving wheel in place to the main frame fastening H-M2-4 hex screw from the upper hole of 2-26 Dummy Brake L.H. and 2-27 for R.H. Fasten H-M2-12 hex screw from the lower hole of 2-26 Dummy Brake L.H. and 2-27 for R.H. to fully secure them using N-M2 Nut.
3. Attach 2-23 Oil Distributor L.H. (2-24 for R.H.) in place to the outside of the main frame and fit 2-26 Dummy Brake L.H. (2-27 for R.H.) for the third driving wheels using H-M2-4 hex screw. Make sure to use correct piece of 2-23 Oil Distributor L.H. and 2-24 Oil Distributor R.H. Install 2-33 Dummy Sander Nozzle for L.H., 2-34 Dummy Sander Nozzle for R.H. and 2-32 Brake Beam to inside of the main frame and fasten H-M2-12 hex screw to secure them.
4. Attach 2-25 Oil Distributor in place to the outside of the main frame and fit 2-26 Dummy Brake L.H. and 2-27 for R.H. for the forth driving wheels in place to the main frame fastening H-M2-4 hex screw from the upper hole of 2-26 Dummy Brake L.H. and 2-27 for R.H. Install 2-34 Dummy Sander Nozzle for L.H., 2-33 Dummy Sander Nozzle for R.H. and 2-32 Brake Beam to inside of the main frame and fasten H-M2-12 hex screw to secure them.
5. Fit 2-26 Dummy Brake L.H. and 2-27 for R.H. for the fifth driving wheels in place to the outside of the main frame using H-M2-4 hex screw. Fasten H-M2-12 hex screw from the lower hole of 2-26 Dummy Brake L.H. and 2-27 Dummy Brake R.H. to fully secure them using N-M2 Nut.

4. INSTALLATION OF SIDE RODS

This section assembles and installs expansion link unit and side rods. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

1. Assembly and Installation of Expansion Link Unit

Assemble the expansion link unit as shown with the illustration.

1. Make Expansion Link unit using 4-1 Radius Rod, 4-2 Expansion Link Pivot Inside, 4-3 Collar, 4-4 Expansion Link, 4-5 Die Block, 4-6 Collar, 4-7 Expansion Link Pivot Outside, 4-8 Pin and C-M1.4-7 countersunk screws, taking note of correct orientation of 4-5 Die Block as shown with Fig.11. Make sure to use the correct pin of 4-8. The dimensions of 4-8 Pin is as shown at the illustration. Note that the dimension of curving line of right and left side of 4-5 Die Block is slightly different from each other. The curving line of right and left side of 4-5 fits to right and left side of interior interface of 4-4 Expansion Link respectively. Do not fit 4-5 Die Block to 4-4 Expansion Link by force and patiently check the correct orientation of 4-5 Die Block. If there is any burr on the die block, carefully remove using the provided sandpaper. Verify the smooth motion of 4-1 Radius Rod after making this unit. If it is binding, use a needle file and eliminate burrs by carefully polishing the interior interface of each Expansion Link contacting with 4-5 Die Block.
2. Refer to Fig.12. Attach 4-15 Expansion Link Support L.H. and 4-12 Expansion Link Support R.H. in place to 1-19 Crosstie using M1.7-4 screws. Insert the longer fork end of 4-16 Reversing Shaft Lever L.H. to the cutout of 4-15 Expansion Link Support L.H. as shown with the balloon in the illustration. Fit the end of 4-9 Reverser Link to the fork end of 4-16 Reversing Shaft Lever L.H. and 4-11 Reversing Arm R.H. respectively using 4-10 Pin. The dimension of 4 -10 Pin is as shown in the illustration. Insert 4-14 Reverser Shaft into the aligned holes of 4-16 Reversing Shaft Lever L.H., 4-23 Bearing, 4-15 Expansion Link Support L.H, 1-19 Crosstie, 4-12 Expansion Link Support R.H, 4-23 Bearing and 4-11 Reversing Arm

R.H. Tightly fasten P-M2.6-3 set screw to 4-11 Reversing Arm R.H. Make sure that temporarily fasten the other P-M2.6-3 set screw to 4-16 Reversing Shaft Lever L.H. This set screw will be fully tighten in the later stage.

3. Install the expansion link units in place as shown with Fig.12, taking note of the correct orientation of expansion link units. Insert the pins of 4-2 Expansion Link Pivot Inside for L.H. to the hole of 1-19 Crosstie and the pin of 4-7 Expansion Link Pivot Outside for L.H. into the hole of 4-15 Expansion Link Support L.H. Make sure to insert the pin of 4-7 Expansion Link Pivot Outside for R.H. to the hole of 4-12 Expansion Link Support R.H. and insert the pin of 4-2 Expansion Link Pivot Inside for R.H. to the hole of 1-19 Crosstie. If 4-2 Expansion Link Pivot Inside and 4-7 Expansion Link Outside do not fit in place, carefully polish the pin of 4-2 Expansion Link Pivot Inside and 4-7 Expansion Link Pivot Outside with your needle file. Fit the end of 4-9 Reverser Link in place to 4-1 Radius Rod using 4-10 Pin as shown with the encircled illustration in Fig. 12. Make sure to use the correct pin of 4-10.
4. Attach 4-13 Reversing Rod Guide in place to 1-19 Crosstie using M1.7-4 screws.

2. Installation of Side Rods

1. Insert the pin of each driving wheel into the holes on 4-17 Coupling Rod L.H. and 4-18 Coupling Rod R.H, taking note of correct orientation of each coupling rod. Fasten C-M2-4(SUS) countersunk screws to the pins of the first driving wheel using 4-19 Washer and to the second driving wheel using 4-19c countersunk washer. Fasten N-M2 (SUS) Nuts to the thread of the forth and fifth driving wheels using 4-19 Washers.
2. Insert the small end of 4-20 Main Rod L.H. and 4-21 Main Rod R.H. in place into 1-4 Crosshead L.H. and 1-5 Crosshead R.H. respectively and fasten 4-22 Crosshead screw. The dimension of 4-22 is shown at the illustration. Insert the pin of the third driving wheel into the big end of 4-21 Main Rod L.H. and 4-20 Main Rod R.H respectively.
3. Verify the smooth rotation of the driving wheels after installing the side rods. Frequently check the smooth motion of each moving part during assembly.

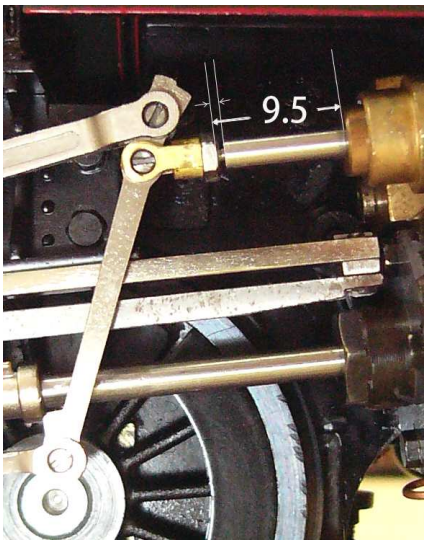
5. ASSEMBLY OF PISTON VALVE AND REVERSING GEAR DEVICE

This section assembles piston valve device and reversing gear device. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

1. Assembly of Piston Valve Device

Assemble the piston valve device as shown with the illustration.

1. Check the orientation of the 5-1 right hand and 5-2 left hand Return Crank as shown in Fig 13. Fit the Return Cranks in place to the pin of the 3rd driving wheel using P-M2-2.5 set screw.
2. Fit the fork end of 5-15 Eccentric Rod in place to 4-4 Expansion Link and fasten 5-18 Pin. Make sure to use correct pin referring to the dimension shown in the illustration. Fasten 5-16 Crank Pin to the aligned holes of the big end of 5-15 Eccentric Rod and 5-1 Return Crank Outside. The correct dimension of 5-16 Crank Pin is shown at the top left of the illustration.
3. Refer to Fig. 14. Fit PR-6 Piston Rings to the grooves of 5-8 Piston Valve. Apply a drop of light machine oil to 5-8 Piston Valve and insert it into 5-5 Steam Chest. Tightly screw 5-6 Piston Valve Spindle into 5-8 Piston Valve. Fasten N-M2 Nut and 5-7 Fork End to the other thread of 5-6 Piston Valve Spindle. The length between the edge of 5-8 Piston Valve and N-M2 nut should measure 9.5mm as shown with the illustration and the photo. This length will be re-adjusted in the valve setting if necessary.



4. Insert the pins of 5-5 Steam Chest into the correct holes of 5-3 Steam Distribution Block L.H. and 5-4 Steam Distribution Block R.H. after fitting PS3-1.9 O-rings in place to 5-3 Steam Distribution Block L.H. and 5-4

Steam Distribution Block R.H. Make sure to use correct piece of 5-3 Steam Distribution Block L.H. and 5-4 Steam Distribution Block R.H.

5. Apply small amount of packing compound to the thread of M3-4 (BS) and fasten it in place to 5-14 Exhaust Block.
6. Installation of the piston valve device on cylinder block must be taken place when fitting 5-14 Exhaust Block to 5-3 Steam Distribution Block L.H. and 5-4 Steam Distribution Block R.H. Refer to Fig. 15. Apply PS3-1.9 O-rings in place to 5-3 Steam Distribution Block L.H. and 5-4 Steam Distribution Block R.H. Apply PS3-1.9 O-rings in place to 1-3 Cylinder Block. Apply small amount of packing compound to the smaller holes on the bottom face of 5-3 Steam Distribution Block L.H. and 5-4 Steam Distribution Block R.H. which will be contacting 1-3 Cylinder Block as shown with the dotted balloon in Fig.15 in the illustration.
7. Install piston valve device on cylinder block and fasten M2.3-8 screws, inserting the pins of 5-14 Exhaust Block in place to 5-3 Steam Distribution Block L.H and 5-4 Steam Distribution Block R.H respectively. Verify that steam pipes on 5-14 are perfectly directed upward.
8. Install 5-13 Combination Lever to the fork end of 4-1 Radius Rod and 5-7 Fork End fastening 5-17 Pin. The dimension of 5-17 Pin is shown in the illustration. Fit fork ends of 5-12 Union Link to the end of 5-13 Combination Lever and 1-4 Cross Head L.H. (1-5 for R.H.) respectively using 5-17 Pin. If the fork end of 5-12 does not fit in place to the cross head, carefully polish the inside of the fork end with your needle file.

2. Assembly of Reversing Gear Device

1. Refer to Fig. 16. Fasten 5-10 Reversing Rod to the hole of 5-9 Reverser Fork End using N-M2 nut.
2. Install 5-10 Reversing Rod through the hole of 1-20 Axle Driven Pump Holder, fitting 5-9 Reverser Fork End to the hole of 2-7 Reverser Lever and fasten 5-17 Pin. The dimension of 5-17 Pin is shown at the illustration.
3. Fit 5-11 Reverser Block to the fork end of 4-16 Reversing Shaft Lever L.H. using

5-18 Pin. Fasten 5-10 Reverser Rod to the threaded hole of 5-11 Reverser Block using N-M2 Nut. Make sure that N-M2 Nut does not run off the edge of 5-11 Reverser Block referring to the balloon in Fig. 16 in the illustration. The length between N-M2 nuts should measure 181.7 mm at the neutral position as shown with Fig.16.

4. Locate 4-1 Radius Rods at the middle of Expansion Link and fully tighten P-M2.6-3 set screw which has been temporarily fastened to 4-16 Reversing Shaft Lever L.H. 4-11 Reversing Arm R.H. and 4-16 Reversing Shaft Lever L.H. should be in phase when the neutral position is correctly set.

6. VALVE SETTING

Set the valve gear correctly referring to the illustration and instruction. It is highly recommended to study the function of each component of valve gear in this section.

The illustration shows the valve gear, the cylinder and the wheels on left hand side.

The angle of return crank of this model is fixed. You will set the valve gear in the following steps.

1) Set the neutral position
2) Set the piston valve by adjusting the length of “A” as shown with the top of the illustration, checking the amount of Lap 1, Lap 2, S1 and S2 as shown in the illustration.

Setting the Neutral Position

Set the Reverse Gear Handle at neutral position where the oval hole of 2-7 Reverser Lever and 2-8 Reverser Holder are aligned by means of 2-11 Reversing Handle. Rotate the wheels and locate the crank pin at the foremost position and verify that the piston is located at the front dead end as shown with the top of the illustration. The center of the hole on 4-5 Die Block and the center of the pin of 4-7 Expansion Link Pivot Outside are aligned when the neutral position is correctly set. Verify that 4-1 Radius Rods are resting at the middle in the Expansion Link and that 4-11 Reversing Arm R.H. and 4-16 Reversing Shaft Lever L.H. are in phase. Give the wheels a few turns and verify that 4-1 Radius Rods hardly move at the neutral position.

Piston Valve Setting

1. Set the Reverse Gear Handle at Forward Running Position by means of 2-11 Reversing Handle. Rotate the wheels and locate the crank pin at the foremost position (as shown with Ⓐ) and check the amount of Lap 1.
2. Set the crank Pin at 90 degrees as shown with Ⓑ and check the amount of S1.

3. Set the Crank Pin at 180 degrees as shown with Ⓒ and check the amount of Lap 2. Verify that Lap1 as shown with Ⓐ and Lap 2 as shown with Ⓒ are the same amount.
4. Set the Crank Pin at 270 degrees as shown with Ⓓ. Verify that S1 as shown with Ⓑ and S2 as shown with Ⓓ are the same amount. If it is not obtained, slacken N-M2 nut and 5-7 Fork End and patiently adjust the amount of Ⓢ by turning the head of 5-8 Piston Valve clockwise or counter clockwise with a minus head driver as shown with the illustration.
5. Set the Reverse Gear Handle at Backward Running Position and repeat the same sequence described above to obtain the same amount of S1 and S2 as shown with Ⓕ and Ⓗ. If it is not obtained, slacken N-M2 nut and 5-7 Fork End and patiently adjust the amount in the same sequence described above. In design, the amount of S1 and S2 for backward running position is slightly smaller than that for forward running position.
6. Repeat the same sequence with Piston Valve on right hand side.

7. AIR TEST OF RUNNING GEAR

In this section, you will give a test run to the running gear. Verify the reliable performance of your running gear assembly at this stage.

Installation of Steam Pipe

Refer to Fig. 18. Install 7-2 Steam Pipe to the correct hole of 5-3 Steam Distribution Block L.H. and 5-4 Steam Distribution Block R.H. after applying thin coat of packing compound to the edge of 7-2 Steam Pipe which is contacting 3-10 Axle Driven Pump Bolt and 5-3 Steam distribution Block L.H. (5-4 for R.H.) as instructed in the illustration. Fasten 3-10 Axle Driven Pump Bolt. 5-14 Exhaust Block has shouldered exhaust pipes. Verify that the copper pipe of 7-2 Steam Pipe is contacting the shouldered exhaust pipe of 5-14 Exhaust Block of which diameter is ϕ 3.5mm as shown with Fig. 18.

Pre-testing notes;

Use your Aster Tread Mill and your air pressure source (both not provided in kit) such as air-compressor. Apply adequate amount of packing compound to the edge of a hole of 15-1 Super Heater as shown with Fig. 19. Fasten 15-2 Banjo Bolt through the hole of 15-1 Super Heater using 7-1 Nut as shown with Fig.19. Temporarily install 15-1 Super Heater to the running gear and fasten 3-10 Axle Driven Pump Bolts which will be used in section 16. Locate BT-ϕ5 tube, HC-1, 27-10 Union Nut and 27-9 Pipe Union and temporarily install them as shown. Soapy water is also necessary to find leaking area.

AIR TESTING

Apply machine oil (not provided in kit) to all moving parts such as side rod bearings, driver axle boxes, crosshead etc. Giving a test on compressed air without lubrication can be damaging to the mechanism. Spray soapy water on cylinders and all joints. Set your running gear to the neutral position handling the reverser and place it on the tread mill. Fit the BT5 tube to your air pressure source tightly and apply 1 to 2 kg/㎠ to your running gear

assembly. Check the smooth rotation of the wheels and presence of the bubble of soapy water. Smooth rotation of each driver is critical to the reliable performance of this engine. Set the gear to Forward and Backward position and check the smooth rotation respectively. Your running gear assembly is in ideal condition when it shows slow and smooth rotation of each driving wheels at the air-pressure of 1 kg/㎠. If soap babble appears on the pressurized running gear, mark the leaking area and fittings and then carefully solve the problem with packing compound later.

DETACHING TEMPORARILY FITTED COMPONENTS

After the test, detach BT-ϕ5 tube, HC-1, 27-9 pipe union, 27-10 Union Nut, 3-10 Axle Driven Pump Bolts, and 15-1 Super Heater. Keep them in safe place until the later sections.

Wipe off soap babble and oil on your running gear assembly before going on to the next stage.

8. ASSEMBLY AND INSTALLATION OF PILOT TRUCK AND OIL TANK

This section assembles and installs pilot truck and oil tank. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

1. Assembly of Pilot Truck

Assemble the pilot truck as shown with the illustration.

1. Attach 8-2 Guard Iron in place to 8-1 Pilot Truck Frame fastening M2-4 screws as shown with Fig. 20.
2. Fit 8-4 Spring and 8-5 Pilot Truck Shaft in place to 8-6 Pilot Truck Wheel Holder using M1.4-3 screws and W-ϕ2 washers as shown with Fig. 21.
3. Fit 8-6 Pilot Truck Wheel Holder in place to 8-1 Pilot Truck Frame fastening M1.7-4 screws and M2-4 screws from underneath of 8-1 Pilot Truck Frame.
4. Put 8-12 Spring into the axle box of 8-3 Pilot Truck Wheels. Install 8-3 Pilot Truck Wheel to 8-6 Pilot Truck Wheel Holder and fasten M2-4 screw to secure the wheels.
5. Assemble the oil tank using 8-7 Oil Tank Holder, 8-8 Oil Tank Cap, 8-9 Oil Tank Band Iron, 8-10 Oil Tank, PN5-1.9 O-ring and M2-4 screws as shown with Fig. 22. Add TT ϕ3 Teflon Tube to end of oil tank pipe.
6. Install the oil tank to the main frame using M2-4 as shown with Fig. 23.
7. Insert 1-33 Pilot Truck Radius Fulcrum into the oval hole of 8-1 Pilot Truck Frame after fitting 8-11 Pilot Truck Spring and W-ϕ4 Washers in place and fitting the fork end of 8-7 Oil Tank Holder to the center of 8-5 Pilot Truck Shaft. Clip E-ϕ3 E-ring to the groove of 1-33 Pilot Truck Radius Fulcrum. Insert 1-28 Bearing to the hole of 8-1 Pilot Truck Frame and fasten M2.6-6 screw from underneath of 8-1 Pilot Truck Frame to secure the pilot truck.

9. INSTALLATION OF CYLINDER COVER AND OTHER COMPONENTS

This section installs cylinder cover, dummy lubricator link and smoke box saddle. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

1. Installation of Cylinder Cover

1. Refer to Fig. 24. Attach 9-1 Drain Valve Nozzle L.H. and 9-2 Drain Valve Nozzle R.H. to the correct holes of 1-3 Cylinder Block fastening M2-4 screws. Fit 9-5 Cylinder Front Panel in place to 5-5 Steam Chest and cap the head of 5-5 Steam Chest with 9-3 Cylinder tail Cover R.H. and 9-4 Cylinder Tail Cover L.H., fastening M2-8 screw. Do not overtighten or it may restrict the stroke of the piston valve.
2. Fit 9-6 Spindle Guide L.H. and 9-7 Spindle Guide R.H. in place to 5-5 Steam Chest and fasten M2-8 screw. Do not overtighten. Verify that 9-6 Spindle Guide L.H. and 9-7 Spindle Guide R.H. do not bind 5-13 Combination Lever or 4-1 Radius Rod.
3. Cover the cylinder using 9-9 Cylinder Cover L.H. and 9-10 Cylinder Cover R.H. Attach 9-8 Dummy Snifting Valve to the top of the 9-9 Cylinder Cover L.H. and 9-10 Cylinder Cover R.H. fastening M2-4 screws. Fit 9-11 Dummy Drain Valve L.H. and 9-12 Dummy Drain Valve R.H. to the bottom of 9-9 Cylinder Cover L.H. and 9-10 Cylinder Cover R.H. and fasten M2-4 screws from underneath of 9-11 Dummy Drain Valve L.H. and 9-12 Dummy Drain Valve R.H.

2. Installation of Dummy Lubricator Link

1. Refer to the Fig. 25 to assemble the dummy lubricator link. Insert the pin of 9-17 Dummy Lubricator Link to the hole of 9-13 Dummy Lubricator Lever L.H. and 9-14 Dummy Lubricator Lever R.H. and carefully clip the fork end of 9-17 Dummy Lubricator Link with your pliers. Insert the other side pin of 9-17 Dummy Lubricator Link to the hole of 9-16 Dummy Lubricator Crank and repeat the same sequence.
2. Insert the pin of 9-13 Dummy Lubricator Lever L.H. and 9-14 Dummy Lubricator Lever R.H. into the hole of 9-15 Dummy Lubricator. Insert SP-ϕ1 Split Pin into the

hole on the pin of 9-13 Dummy Lubricator Lever L.H. and 9-14 Dummy Lubricator Lever R.H. Carefully bend the inserted pins of SP- ϕ 1 outward as shown with the illustration.

3. Install the above dummy lubricator link in place fastening M2-4 screws to the correct holes on main frame and fastening M1.4-3 screws to the threaded hole of 4-7 Expansion Link Pivot Outside for both hand sides.

3. Installation of Smoke Box Saddle

1. Cut the ceramic sheet as shown with the measurements in the illustration. Attach correctly-cut ceramic sheet pieces of 9-18 Smoke Box Saddle with packing compound and allow them to dry.
2. Install 9-18 Smoke Box Saddle in place to the main frame letting the steam pipes into the square cutouts of 9-18 Smoke Box Saddle and fasten M2-4 screws from both sides of 9-18 Smoke Box Saddle. Apply small amount of packing compound to the thread of M2-4 screw and fasten it from 9-18 Smoke Box Saddle to 5-14 Exhaust Block.

10. ASSEMBLY OF FRONT BUFFER FITTINGS

This section assembles front buffer fittings. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

1. Refer to Fig. 26. Insert the pin of 10-1 Buffer Head to the hole of 10-10 Buffer Stock. Attach 10-8 Buffer Beam Plate to 10-7 Front Buffer Beam, fitting 10-9 Buffer Spring into 10-1 Buffer Head and fasten 10-5 Buffer Stock Bolt into the aligned holes of 10-7 Front Buffer Beam, 10-8 Buffer Beam Plate and 10-10 Buffer Stock. Fasten 10-4 Buffer Shank to secure the front buffer.
2. Insert the pin of 10-2 Hook Coupler into the aligned square holes of 10-8 Buffer Beam Plate and 10-7 Front Buffer Beam, slip-fitting 10-6 Coupler Spring and W-ϕ 2.6 Washer to the pin of 10-2 Hook Coupler. Insert SP-ϕ 1 Split Pin into the hole on the pin of 10-2 Hook Coupler and carefully bend the split pin outward to secure 10-2 Hook Coupler.
3. Temporarily detach 8-8 Oil Tank Cap and keep it in safe place. Attach 10-3 Front Deck in place to the top of 10-7 Front Buffer Beam using M2-4 screws.
4. Slide-fit the above unit of front buffer to the cutout of the main frame and fasten M2-4 screws from both sides of the frame to secure it.
5. Insert the pin of 10-12 Front Deck L.H. for and 10-13 Front Deck R.H. into the slit on the main frame and fasten M2-4 screw into 10-7 Front Buffer Beam as shown with Fig. 27. Attach 10-11 Front Step in place to 10-3 Front Deck, inserting the lugs of 10-11 to the holes on 10-3 Front Deck, and fasten M2-4 screws to secure 10-11 Front Step. Fit 8-8 Oil Tank Cap to the oil tank.
6. Fit 10-17 Front Step L.H. and 10-18 Front step R.H. in place to the backside of 10-7 Front Buffer Beam. Fasten M2-4 screw to secure 10-17 Front Step L.H. and 10-18 Front Step R.H. fitting 10-14 Lamp Iron in place.
7. Fit the pin of 10-19 Dummy Hose in place to the pin of 10-17 Front Step L.H. and 10-18 Front Step R.H. using M2-4 screw from underneath of 10-19 Dummy Hose.

8. Attach the 10-15 Works Plate to the outside walls of the main frame using double sided adhesive tape. The correct location of attaching the works plates is as shown with the illustration.

11. ASSEMBLY OF INNER BOILER (1)

This section partially assembles the inner boiler. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

Care must be taken when handling 11-9 Inner Boiler.

1. Cut the ceramic sheet (provided in kit) to fit inside of 11-1 Fire Box. The dimension is as shown with the illustration. Attach the correctly cut pieces A, B, C, D and E in place inside of the fire box, applying packing compound between the sheet and the fire box as shown with the illustration. Make sure to double the ceramic sheet pieces of E.
2. Install the fire box to 11-9 Inner Boiler attaching 11-2 Cabin Back Head using M2.6-4 screws. Fasten M2.6-4 screw into the bottom of 11-9 inner Boiler to secure the fire box.
3. Fit LN5-7 Lock Nut to 11-6 Blower Valve Body. Insert 11-6 Blower Valve Body into the correct tube in 11-9 Inner Boiler after applying adequate amount of packing compound as instructed with the sign in the illustration and fasten LN5-7 Lock Nut to secure 11-6 Blower Valve Body. Verify that no excess compound exude from the joint. Fasten 11-5 Blower Valve Needle into the hole of 11-6 Blower Valve Body after applying PF2-1.5 O-ring to the groove of 11-5 Blower Valve Needle.
4. Install 11-4 Blower Valve Handle to the end of 11-5 Blower Valve Needle using P-M2.6-3 set screw to secure the handle.
5. Fit LN10-12 Lock Nut to 11-8 Regulator Body and insert 11-8 Regulator Body into the correct tube in 11-9 Inner Boiler fastening LN10-12 Lock Nut, applying adequate amount of packing compound to the thread of 11-8 Regulator Body as instructed with the sign in the illustration. Make sure that the hole on 11-8 Regulator Body is in upward direction as shown with the illustration. Verify that no excess compound exude from the joint.
6. Fit (2) PF4-1.9 O-rings and PS3-1.9 over the correct grooves of 11-7 Regulator

Valve Needle respectively and insert 11-7 Regulator Valve Needle into the tube of 11-8 Regulator Body.

7. Install 11-3 Regulator Valve Handle to the shouldered end of 11-7 Regulator Valve Needle using P-M2.6-3 set screw.

12. ASSEMBLY OF INNER BOILER (2)

This section continues to assemble the inner boiler. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

1. Installation of Pressure Gauge, Water Gauge Glass and Blow-Down Valve

1. Apply thin coat of packing compound to the edge of 12-4 Steam Pipe as instructed with the sign, and install it into the inner boiler by fastening 3-10. Connect the end of 12-4 Steam Pipe to the thread of 11-6 Blower Valve Body by fastening the nut of 12-4 Steam Pipe.
2. Connect 12-9 Siphon Tube for Pressure Gauge to the thread of 11-6 Blower Valve Body fastening a GN-5-3 nut to the crimped end of 12-9 Siphon Tube. Insert other end of Siphon Tube to larger end of 11-2 Miura Joint. Install PG-ϕ20 Pressure Gauge to the other end of 11-2 Miura Joint and fasten GN-5-3 nut to seal.
3. Apply a thin coat of packing compound to the thread of 12-2 Gauge Glass Holder and install it to the correct tube of 11-9 Inner Boiler fastening LN5-7 Lock Nut.
4. Apply thin coat of packing compound to the pipe of 12-5 Water Pipe and fasten 12-6 Banjo Bolt. The dimension of 12-6 Banjo Bolt is as shown at the left bottom of the illustration.
5. Apply thin coat of packing compound to the thread of 12-5 Water Pipe and connect the thread of 12-5 Water Pipe through 11-2 Cabin Back Head to 12-7 Blow-Down Valve Body using LN5-7 Lock Nut. Verify that no excess compound exude from the joints. Make sure that 12-2 Gauge Glass Holder and 12-7 Blow-Down Valve Body are in alignment. Locate 27-4 Pump Extension Handle from section 27 and insert it into the bores of 12-2 Gauge Glass Holder and 12-7 Blow-Down Valve Body to verify the perfect alignment.
6. Insert 12-1 Water Gauge Glass in place applying PN6-1 O-ring and GN8-6B Gland Nuts. Carefully fasten gland nuts to let the red line on the glass face the back head of the boiler.

7. Fasten 12-3 Gauge Glass Holder Cap applying thin coat of packing compound to the thread.
8. Install 12-8 Needle Valve to 12-7 Blow-Down Valve Body after applying PF2-1.5 O-ring to the groove of 12-8 Needle Valve.
9. Install 12-10 Steam Inlet to the hole of 11-8 Regulator Body.

2. Boiler Leak Test

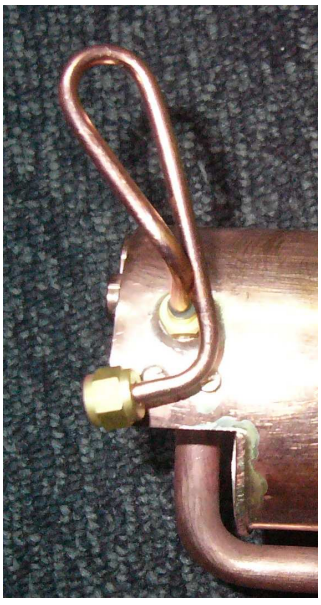
In this test, you will check your boiler assembly for leakage. Carefully give a test to your boiler.

Before you test;

For hydraulic test, use one of your Aster engines which have the tender water pump or you may use your track side pump.

Testing Boiler

1. For this test, fasten 15-8 Safety Valve using PS5-1.9 O-ring in place and fasten 15-5 Plug using FG- ϕ 8 in place referring to the illustration of section 15.
2. Close 11-5 Blower Valve Needle, 11-7 Regulator Valve Needle, 12-8 Blow-down Needle Valve by means of each handle. Fill the inner boiler with water through the boss on 11-9 boiler by means of injection syringe provided in kit.
3. Connect 22-13 Water Pipe which will be used in section 22 to the boss on 11-9 Inner Boiler as shown with the right picture. Connect the tube of 22-13 to your water pump.
4. Pump Water from the tender water tank or track side pump. Frequently check PG-20 Pressure Gauge until the pressure of the inner boiler reaches 4kg/㎠.
5. When the Pressure Gauge shows a reading of 3 to



4 kg/㎠, carefully check water leakage from joints and fastenings, marking the leakage area if any. After you finish checking all the leaky area, drain the water from the inner boiler to remove the leaky fitting and repack the threads with packing compound. Repeat the same sequence until you verify that no leak is present.

After the test;

Detach 22-13 Water Pipe, 15-8 Safety Valves and 15-5 Plug and keep them in safe place.

13. ASSEMBLY OF BOILER CASING

This section assembles boiler casing. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

1. Fit 13-4 Dummy Washout Plug in place to inside of 13-3 Boiler Casing using M1.2-3 screws.
2. Attach 13-6 Dummy Blow-off Cock in place to the inside of 13-3 Boiler Casing and insert the lugs of 13-5 Side Step to the aligned square holes of 13-3 Boiler Casing and 13-6 Dummy Blow-off Cock, carefully bending the lugs outward.
3. Attach 13-7 Dummy Washout Plug and 13-9 Dummy Washout Plug in place to the inside of 13-3 Boiler Casing and fasten 13-2 Handrail Stanchions to secure them.
4. Fit 13-8 Dummy Regulator Lever in place to 13-3 Boiler Casing, fitting the edge of 13-8 Dummy Regulator Lever to the square hole of 13-3 Boiler Casing as shown with the inset in the illustration, and fasten M1.2-3 screw to secure 13-8 Dummy Regulator Lever.
5. Fasten the remaining 13-2 Handrail Stanchions in place to 13-3 Boiler Casing.
6. Insert the lugs of 13-10 Dummy Regulator Valve in place to the square hole of 13-3 Boiler Casing and carefully bend them outward.
7. Attach 13-11 Dummy Check Valve L.H. and 13-12 Dummy Check Valve R.H. to the inside of 13-3 Boiler Casing and secure them using 1.2-3 screws.

14. INSTALLATION OF INNER BOILER TO BOILER CASING

This section installs inner boiler to the boiler casing. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

1. Cut the ceramic sheet (provided in kit) to the size as shown with the illustration. Attach the correctly cut piece of the ceramic sheet to the front of the inner boiler, applying packing compound between the sheet and the boiler as shown with the illustration. The ceramic sheet should run off the end of the inner boiler by 5 to 7 mm as shown with the illustration.
2. Install the inner boiler into the boiler casing, fastening M2-4 screws in place to the rear holes on boiler casing.
3. Install 14-1 Boiler Ring to the front end of the boiler casing and fasten M2-4 screws in place. Take note of the correct orientation of 14-1 Boiler Ring when installing it. Slightly bend the front end of the ceramic sheet to the inside for easier installation of 14-1 Boiler Ring as shown with the illustration.

15. INSTALLATION OF SUPER HEATER AND OTHER COMPONENTS

This section installs super heater and other components to the boiler. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

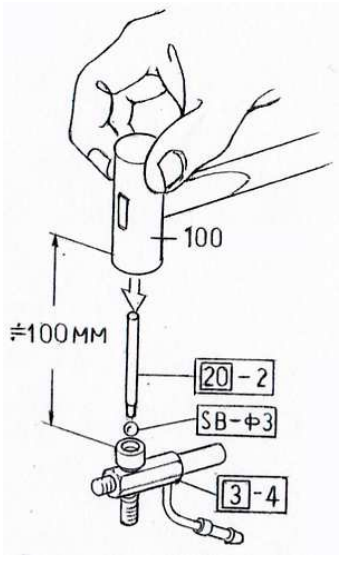
1. Apply a thin coat of packing compound to the edge of the hole of 15-1 Super Heater as instructed with the sign in the illustration and install 15-1 Super Heater to the correct tube of inner boiler with a PS4-1.9, fastening 15-2 Banjo Bolt. Make sure no excess compound exude from the joint. The dimension of 15-2 Banjo Bolt is as shown with the left side of the illustration.
2. Apply packing compound to the pipe of 15-3 Exhaust Nozzle as shown with the sign in the illustration and install it fastening 15-4 Banjo Bolt. Make sure no excess compound exude from the joint. The dimension of 15-4 Banjo Bolt is as shown with the left side of the illustration.
3. Apply packing compound to the thread of 15-5 Plug and fasten 15-5 Plug in place into the boiler after applying FG-ϕ8 Fiber Gasket in place. Fit 15-6 Steam Dome to 15-5 Plug using M2-4 screw.
4. Install 15-8 Safety Valve in place after fitting PF5-1.9 O-ring to the groove of 15-8 Safety Valve. Attach 15-7 Safety Valve Cover in place to the boiler casing using M1.4-3 screws.
5. Install 15-9 Dummy Manifold in place using M1.4-5 screw.
6. Mount 15-13 Weight in place to the rear of boiler casing, fitting 15-11 Fire Box Casing L.H. and 15-12 Fire Box Casing R.H. in place. Fasten M2-8 screws from the outside of 15-11 Fire Box Casing L.H. and 15-12 Fire Box Casing R.H. to secure the weight, 15-11 Fire Box Casing L.H. and 15-12 Fire Box Casing R.H. Attach 15-10 Fire Box Front in place to the shouldered wall of 15-11 Fire Box Casing L.H. and 15-12 Fire Box Casing R.H. fastening M2-4 screws. Make sure to install 15-11 Fire Box Casing L.H., 15-12 Fire Box Casing R.H. and 15-10 Fire Box Front to the highest position making use of the play of screws.

16. MOUNTING THE BOILER ASSEMBLY

This section mounts the boiler assembly on the running gear. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

1. Mounting the Boiler Assembly

1. Mount the boiler assembly on the running gear. Apply thin coat of packing compound to the pipe of 7-2 Steam Pipe as instructed with the signs. Fit the block of 15-1 Super Heater in place to 7-2 Steam Pipe and fasten 3-10 Axle Driven Pump Bolt to the aligned holes of 7-2 Steam Pipe and 15-1 Super Heater. Make sure that no excess packing compound exudes from the joint. Connect the downward hole of 15-1 Super Heater to the pipe of 8-10 Oil Tank fastening a nut of 8-10 Oil Tank and sealing TT ϕ 3 Teflon Tube as shown in 8-Fig 22.
2. Fasten M2.6-6 screw using W- ϕ 2.6 Washer from underneath of 1-11 Boiler Support to secure the boiler.
3. Insert SB- ϕ 3 Stainless Steel Ball into 3-4 By-pass / Check Valve Body. Put 20-2 Reach Rod on the ball and strike it once with a weight of 100g (not provided in kit) from the point where it is approximately 100 mm distant from the By-pass / Check Valve Body to set the ball inside the housing as shown with the illustration at the right. Do not strike the ball too hard or more than once. Usually, the ball could come to sit inside of the housing on its own after repeating the operation even if you omit this work.



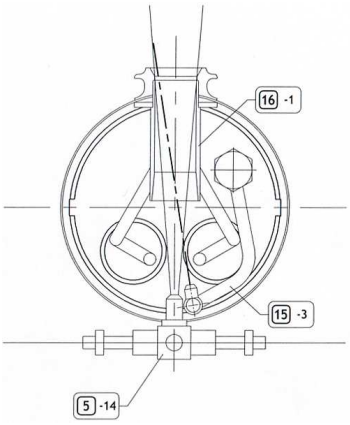
4. Install 16-5 Water Pipe in place after applying packing compound to the pipe of 16-5 Water Pipe as instructed with the sign. Fasten 16-6 Banjo Bolt to the lower pipe of 16-5 Water pipe. Fasten 3-10 Axle Driven Pump Bolt to the upper pipe of 16-5 Water Pipe.

The dimension of 16-6 Banjo Bolt is as shown at the right bottom of the illustration.

5. Cut BT-ϕ5 Back Tube to measure 45mm and fit one end of the tube to the pipe of 12-7 Blow-down Valve Body and insert the other end of the tube to the hole on the cab floor.
6. Fasten M2-4 to secure 11-2 Cabin Back Head with the cab floor.

2. Installation of Smoke Box

1. Cut the ceramic sheet (provided in kit) to fit the inside of 16-2 Smoke Box to keep air tight in the smoke box. The dimension is as shown at the left side of the illustration. Attach correctly cut piece of the ceramic sheet to inside of 16-2 Smoke Box, applying packing compound between the sheet and inside of the smoke box.
2. Install 16-1 Inner Chimney in place on the pipes of 5-14 Exhaust Block, taking note of the correct orientation of 16-1 Inner Chimney. Install 16-2 Smoke Box to 9-18 Smoke Box Saddle and fasten M2-2.5 screws from each side of 16-2 Smoke Box Saddle. Fit 16-3 Chimney in place to 16-2 Smoke Box verifying the alignment of the hole. Fit 16-4 Chimney Top to 16-3 Chimney fastening to secure 16-3 Chimney, 16-4 Chimney Top and 16-1 Inner Chimney. Verify that 5-14 Exhaust Block and 15-3 Exhaust Nozzle are correctly positioned referring to the illustration at the right in this page.



3. Fasten M2-2.5 screw to 14-1 Boiler Ring from the top of 16-2 Smoke Box.
4. Fasten 13-2 Handrail Stanchion in place to 16-2 Smoke Box using N-M2 nut.

17. ASSEMBLY AND INSTALLATION OF CABIN

This section assembles and installs the cabin. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

1. Fit in 17-2 Front Window Frame L.H and 17-3 Front Window Frame R.H to each front window on 17-4 Cabin and carefully bend the lugs outward to secure them.
2. Install 17-6 Sash L.H and 17-7 Sash R.H. from inside of the cabin fitting 17-5 Glass in place. Insert the pins of 17-10 Windshield Frame to the aligned holes of 17-4 Cabin, 17-5 Glass and 17-6 Sash L.H. (17-7 Sash R.H.), and carefully bend them outward to secure the window and window frame.
3. Insert the pins of 17-8 Gutter L.H. and 17-9 Gutter R.H. in place above the side window.
4. Refer to TEMPLATE ① to make the handrails using wire-ϕ1. Install handrails in place to 17-4 Cabin, carefully bending the end of the wires to secure them as shown in the illustration.
5. Slide-fit 17-14 Ventilator to the top of 17-13 Cab Roof, attaching 17-12 Cab Roof Support to the back side of 17-14 Ventilator as shown with Fig. 28. Fasten M1.4-3 screws from underneath of 17-12.
6. Install 17-13 Cab Roof in place to 17-4 Cabin using 1.4-3 screws as shown with Fig. 29.
7. Carefully fit in 17-11 Glass to 17-2 Front Window Frame L.H. and 17-3 Front Window Frame R.H. May require light sanding of Glass to fit securely.
8. Install 17-4 Cabin to the cab floor and fasten M2-4 screws. Take note of the correct holes and directions when fastening each screw.

Installation of 17-1 Reach Rod to the front wall of 17-4 Cabin will take place in section 20.

18. INSTALLATION OF RUNNING BOARD AND FITTINGS

This section installs running board and fittings. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

1. Insert the pin of 18-9 Sand Filler to the correct hole on 18-8 Running Board R.H. and fasten M2-2.5 screw from underneath of the running board to secure 18-9 Sand Filler.
2. Attach 18-12 Injector Pipe End Holder in place to the back side of 18-8 Running Board R.H. fastening M2-2.5 screws from underneath.
3. Insert the pin of the fork end of 18-10 Link into the hole of 4-11 Reversing Arm R.H. and carefully clip the fork end as shown with Fig. 30.
4. Insert the spindle of 18-10 Link to 18-11 Dummy Weight Shaft and install 18-11 Dummy Weight Shaft in place to the back side of 18-8 Running Board R.H., fastening M1.4-3 screws.
5. Install 18-8 Running Board R.H. in place fastening M2-4 screw into 10-13 Front Deck R.H. , 1-11 Boiler Support and 1-20 Axle Driven Pump Holder respectively and fasten M2-4 screw to the aligned holes of 18-8 Running Board R.H. and 17-4 Cabin.
6. Fit 18-14 Pipe Holder in place to the backside of 18-13 Running Board L.H. and fasten M1.4-3 screws from underneath of 18-4 Pipe Holder.
7. Fit 18-15 Handrail to 18-14 Pipe Holder and carefully clip the fork end of 18-14 Pipe Holder with your pliers to secure the handrail as shown with Fig. 31.
8. Install 18-13 Running Board L.H. in place fastening M2-4 screws to 10-12 Front Deck L.H., 1-11 Boiler Support, and 1-20 Axle Driven Pump Holder respectively and fasten M2-4 screw to the aligned holes of 18-8 Running Board R.H. and 17-4 Cabin.
9. Cut the ceramic sheet to fit the inside of 18-7 Smoke Box Front and attach the correctly cut piece of ϕ 60 mm to the inside of smoke box front for air tight with packing compound and allow it to dry.
10. Insert the pins of 18-5 Loco Number Plate 92059 in place to 18-7 Smoke Box Front. Fasten H-M2-6 hex screw to aligned holes of 18-4 Smoke Box Door Handle and the

central hole of 18-7 Smoke Box Front in order to secure 18-4 Smoke Box Door Handle.

11. Insert the pins of 18-2 Smoke Box Shed Plate in place to the holes of 18-7 Smoke Box Front.
12. Fit 18-1 Smoke Deflector Support in place to 18-7 Smoke Box Front using M1.4-3 screw.
13. Install 18-7 Smoke Box Front to the front side of 16-2 Smoke Box using M2-4 screws.

19. INSTALLATION OF SMOKE DEFLECTORS AND OTHER COMPONENTS

This section installs smoke deflectors and other components. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

1. Refer to Fig. 32. Attach 19-1 Smoke Deflector Support L.H. and 19-2 Smoke Deflector Support R.H. to 19-3 Smoke Deflector L.H. and 19-4 Smoke Deflector R.H. respectively. Fasten 13-2 in place using N-M2 nut to secure 19-1 Smoke Deflector Support L.H. and 19-2 Smoke Deflector Support R.H. Fasten the remaining 13-2 Handrail Stanchion in place to 19-3 Smoke Deflector L.H. and Smoke Deflector R.H. Refer to TEMPLATE② to make the handrail using Wire-ϕ1(Black) and insert the handrail into the hole of 13-2 Handrail Stanchions. Temporarily fasten M2-2.5 screw to secure 19-6 Front Ladder L.H. and 19-7 Front Ladder R.H. at this stage.
2. Fit 19-5 Steam Pipe Cover in place to the cutout of 19-3 Smoke Deflector L.H. and 19-4 Smoke Deflector R.H.
3. Install the above smoke deflectors to 16-2 Smoke Box, inserting the pin of 19-3 Smoke Deflector L.H. and 19-4 Smoke Deflector R.H. to the slit on 10-12 Front Deck L.H. and 10-13 Front Deck R.H. and fitting 19-8 Smoke Deflector Support in place. Fasten M1.2-3 screws to secure the smoke deflectors.
4. Fasten M2-4 screw in place to the running board to secure the smoke deflector. Fasten M2-4 screw to 19-6 Front Ladder L.H. and 19-7 Front Ladder R.H., and fully tighten M2-2.5 screw which has been temporarily fastened to secure the front ladders.
5. Install 19-12 Dummy Ejector inserting the pins to the correct holes of the running board and fastening M2-2.5 screw to 16-2 Smoke Box.
6. Attach 19-11 Piping Cover in place to the left side of the boiler casing using M1.2-3 screws and M1.4-3 screw. Take note that M1.4-3 screw is used for the most rear hole on 19-11 Piping Cover.

7. Install 19-10 Control Valve to the boiler casing inserting the pins to 17-4 Cabin and fasten M1.4-3 screw to secure 19-10 Control Valve.
8. Install 19-9 Injector Pipe inserting one end to 13-11 Dummy Check Valve L.H. (13-12 Dummy Check Valve R.H.) using a drop of thread locker such as Loctite 222 if necessary and insert the other end to the correct hole of the running board. The dimension of 19-9 Injector Pipe is as shown with the balloon in the illustration.
9. Cut Wire- ϕ 1 (Black) to measure approximately 231mm and insert it to the holes on 13-2 Handrail Stanchions.
10. Install 19-13 Cabin Plate on the cab floor using M2-4 screws.

20. INSTALLATION OF DETAIL FITTINGS

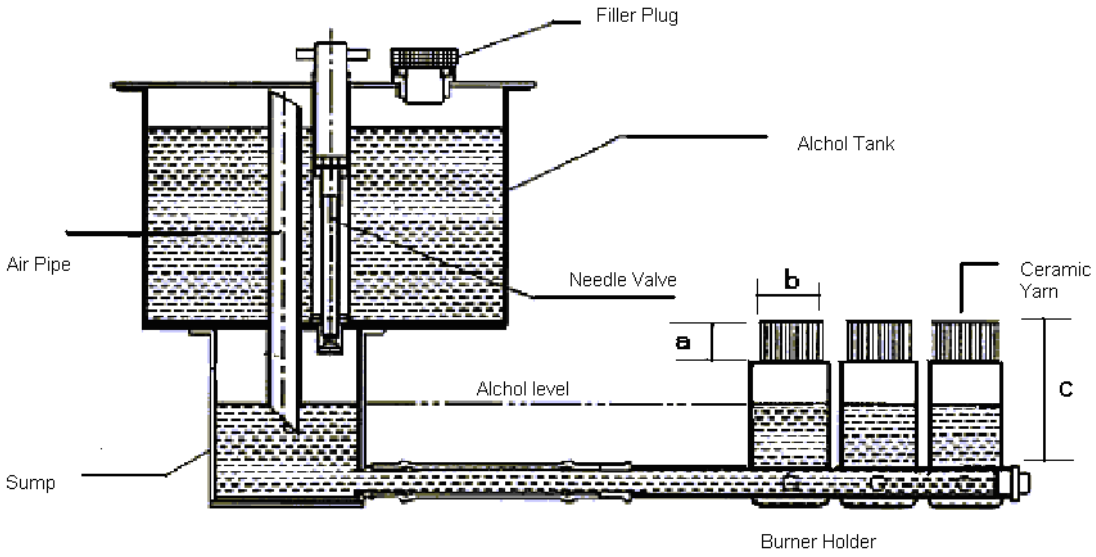
This section installs detail fittings. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

1. Fit 17-1 in place to the front wall of cabin using M1.2-3 screws. Insert the rear end of 20-2 Reach Rod to the hole of 17-1 Reach Rod Guide. Install 20-1 Reverser Cover in place on the left side of running board and fasten M2-4 screw to secure it and insert the other end of 20-2 Reach Rod to 20-1 Reverser Cover, applying small amount of Loctite 222 to the end of 20-2 Reach Rod if necessary.
2. Install 20-3 Regulator Guide in place to the upper front of 17-4 Cabin and fasten M1.4-3 screw to secure it
3. Make dummy pipes using Wire-ϕ1.5 (Copper) and Wire-ϕ1(Black), referring to TEMPLATE ③ and ④ respectively. Insert one end of Wire-ϕ1.5 (Copper) to the correct hole of 15-9 Dummy Manifold and the other end to the correct hole of 19-10 Control Valve. Insert one end of Wire-ϕ1 (Black) to the correct hole of 15-9 Dummy Manifold and fit the other end behind 19-10 Control Valve.
4. Cut Wire-ϕ1(Black) to measure approximately 63 mm. Insert one end of this wire to the correct hole of 13-8 Dummy Regulator Lever and the other to 20-3 Regulator Guide.
5. Cut Wire-ϕ1 (Black) to measure approximately 73 mm. Insert one end of this wire to the correct hole of 13-10 Dummy Regulator Valve and the other end to the correct hole of 13-8 Dummy Regulator Lever.

21. INSTALLATION OF BURNER

This section installs the burner. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

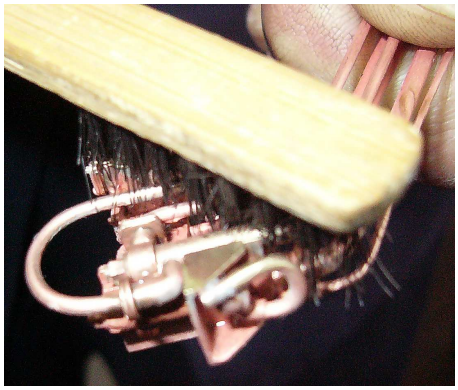
1. Installation of Burner



1. Comb the bundle of 24 to 26 Ceramic Yarns (provided in kit) and evenly cut them with scissors and inset them straight in each holder tube to full depth as shown with the illustration. Do not twist the wicks. Make sure that the length above the burner tube edge (a) measures 10 to 11 mm. The correct length (a) and density (b) are required for a reliable performance of the engine. (The quality of fuel such as water content and contaminations can affect the strength of the fire and therefore the performance of the model.) Generally after inserting the strands into the individual burner tubes, if the burner is inverted then the wicks should not fall out of the burner tubes. Some experimentation when the loco is well “run-in” with burner height and yarn density will allow optimum performance and economy with the model. Yarns will carbonize after repeated firings. Frequently check the

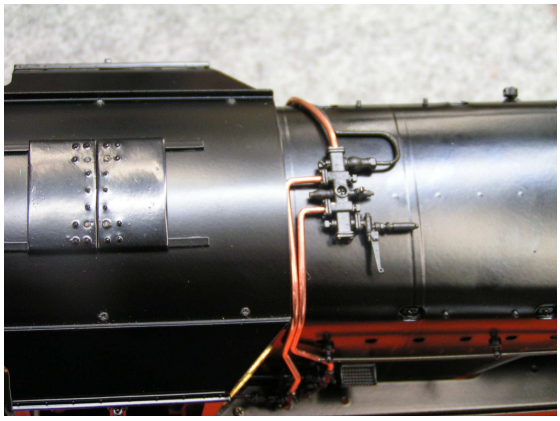
condition and replace them periodically.

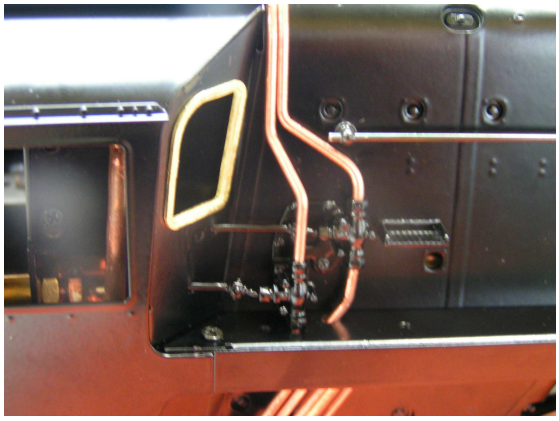
2. Attach 21-1 Burner Holders to each other, fitting the pipe of 21-2 Burner in place to 22-1 Burner Holders and fasten M2-4 screws using N-M2 Nuts as shown with Fig. 33.
3. Insert the pin of 21-2 Burner to the hole of 11-1 Fire box and fasten M2-4 screws to 1-25 Cabin Floor from underneath of 21-1 Burner Holders.
4. Insert the pin of 21-5 Dummy Box in place to 1-25 and fasten M2-4 screw to secure it.
5. Brush 21-4 Dummy Injector as show with the photo below. (A brush is not provided in kit.) Insert the pin of 21-4 Dummy Injector to the correct hole of 1-25 Cabin Floor and fasten M2-4 screws to 3-3 By-pass Valve Bracket from underneath of 21-4 Dummy Injector.



6. File off the pin of 21-3 Control Valve with your needle file as instructed with the balloon in the illustration and install 21-3 Control Valve in place to the right side of the boiler casing using M1.4-3 screw.
7. Cut Wire-ϕ1.5 (Copper) to measure approximately 12 mm as shown with the inset in the illustration. Insert one end of it to the correct hole of 21-3 Control Valve and the other end to the correct hole on the running board R.H.
8. Cut Wire-ϕ1.5 (Copper) to measure approximately 4 mm as shown with the inset in the illustration. Insert one end of it to the correct hole of 21-3 Control Valve and the other end to the correct hole on the running board R.H.
9. Make dummy piping using Wire-ϕ1.5 (Copper) referring to TEMPLATE ⑤ and ⑥. Insert one end of the piping shown with TEMPLATE ⑤ to the correct hole of 15-9 Dummy Manifold and the other end to the correct hole of 21-3 Control Valve.

Insert one end of the piping as shown with TEMPLATE ⑥ to the correct hole of 15-9 Dummy Manifold and the other end to the correct hole of 21-3 Control Valve.



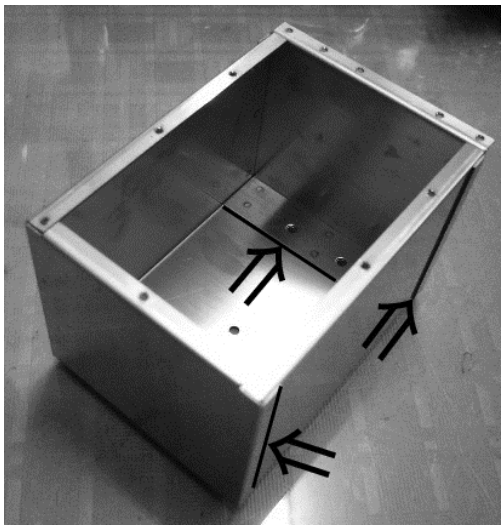


22. ASSEMBLY OF TENDER (1)

This section assembles tender. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

Pre-assembly Notes;

Apply packing compound to the place where the sign ➪ is shown as well as to the seams of water tank in order to avoid water leakage. Sealing is required where arrows indicate in the pictures below. After using the packing compound, make sure to wash your hands before going on to the next step.



1. Installation of Dummy Fittings

1. Insert the lugs of 22-3 Dummy Brake Shaft Bearing L.H. and 22-4 Dummy Brake Shaft Bearing R.H. to the correct holes on 22-1 Tender Frame and carefully bend them outward as shown with Fig. 34.
2. Install 22-2 Tender Front Beam in place to 22-1 Tender Frame using M2-4 screws.

2. Assembly of Hand Pump

1. Make Hand Pump Assembly as shown with Fig. 35 using 22-5 Hand Pump Body, 22-6 Cap, 22-7 Suction Valve Seat, 22-8 Pump Ram, 22-9 Pump Link, 22-10 Pump

Lever, 22-11 Cross Member, 22-12 Ram Pin, SB-ϕ4 Stainless Steel Ball, PN7-1.9 O-ring and N-M2.6 (BS) Nuts, applying adequate amount of packing compound to the thread of 22-6 Cap and 22-7 Suction Valve Seat. Make sure that no excess packing compound interferes with the motion of the stainless steel ball. Apply a drop of light machine oil (not provided in kit) to PN7-1.9 O-ring, and check the smooth stroke of the ram.

2. Connect the threaded protrusion of 22-5 Hand Pump Body to the pipe of 22-13 Water Pipe fastening the nut of 22-13 Water Pipe.
3. Apply adequate amount of packing compound to the thread of 22-14 Water Return Pipe and the hole on 22-15 Water Tank which will be contacting 22-14 Water Return Pipe and fit FG-5 Fiber Gasket to the thread of 22-14 Water Return Pipe. Fasten 22-14 Water Return Pipe into 22-15 Water Tank using LN5-7 Lock Nut.
4. Apply adequate amount of packing compound to the thread of 22-13 Water Pipe and the remaining 3 holes on 22-15 Water Tank as instructed with the signs and fit FG-5 Fiber Gasket to the thread of 22-13 Water Pipe. Install the assembly of hand pump in the water tank, fastening LN5-7 Lock Nut to secure 22-13 Water Pipe. Fasten M2.6-6 (BS) from underneath of 22-17 Water and Fuel Tank Seat, applying adequate amount of packing compound to the thread of screws.

23. ASSEMBLY OF TENDER (2)

This section continues to assemble tender. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

1. Fit 23-2 Access Door in place to the front on 23-1 Tender Body and carefully bend the lugs outward to secure 23-2 Access Door.
2. Fit 23-4 Hand Grab, 23-5 Hand Grab, 23-6 Lamp Iron, 23-7 Hook, 23-8 Hand Grab in place to 23-1 Tender Body and carefully bend each lug outward to secure the fittings.
3. Install 23-1 Tender Body on 22-17 Water and Fuel Tank Seat and fasten M2-4 screws from underneath.

24. ASSEMBLY OF TENDER (3)

This section continues to assemble tender. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

1. Apply adequate amount of packing compound to the thread of M2-4 (BS) screws and the holes on 22-15 Water Tank which are contacting M2-4 (BS) screws and fasten M2-4 (BS) screws into the hole on 22-1 Tender Frame through 22-15 Water Tank.
2. Fasten M2-4 screws in place to secure 23-1 Tender Body to 22-1 Tender Frame.
3. Fit 24-1 Dummy Sieve L.H. and 24-2 Dummy Sieve R.H. in place to 22-1 Tender Frame, inserting the pins of 24-1 Dummy Sieve L.H. and 24-2 Dummy Sieve R.H. into the correct holes on 23-1Tender Body. The hole of 22-1 Tender Frame may require filing to fit hook of 24-1 and 24-2 Dummy Sieves.
4. Cut Wire-ϕ1.5 (Black) to approximately 73.5mm and bend it referring to the inset illustration. Insert one end of this wire to the hole of 24-1 Dummy Sieve L.H. (24-2 for R.H.) and the other end to the hole on 22-2 Tender Front Beam.
5. Carefully connect the pipe of 24-3 Water Delivery Pipe in place to 22-14 Water Return Pipe and 22-13 Water Pipe fastening a nut of 24-3 Water Delivery Pipe.
6. Install 24-4 Fuel Sump to 22-17 Water and Fuel Tank Seat and fasten M2-4 screws from underneath of 24-4 Fuel Sump.
7. Fit 24-8 Dummy Stay in place to 22-1 Tender Frame inserting the pins of 24-8 Dummy Stay in place to 22-17 Water and Fuel Seat.
8. Fit 24-9 Dummy Leaf Spring in place to 22-1 Tender Frame using M1.4-3 screws.
9. Insert the pin of 24-5 Tender Wheels to the correct hole of 24-6 Journal Box. Put 24-7 Spring to the hole on 24-6 Journal Box and install 24-5 Tender Wheels in place to 22-1 Tender Frame, fitting 24-7 Spring to the hole on 24-9 Dummy Leaf Spring. Verify the smooth rotation of the tender wheels.
10. Pour water in the tank and pump water several times by means of 27-4 Pump Extension Handle. Place your finger to the end of 24-3 pipe and check the water

pressure. Observe that the water is forced out from the pump and pushes against your finger. If the pressure is low, then check that SB-ϕ4 Stainless Steel Balls are not missing from your hand pump assembly and that water passages of the pipes are not clogged with excessive packing compound.

25. ASSEMBLY OF TENDER (4)

This section continues to assemble tender. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

1. Assembly of Tender Wheels

1. Fit the remaining 24-9 Dummy Leaf Spring in place to 22-1 Tender Frame using M1.4-3 screws.
2. Insert the pins of the remaining 24-5 Tender Wheels to 24-6 Journal Box and put the remaining 24-7 Spring to the hole on 24-6 Journal Box. Install 24-5 Tender Wheel to 22-1 Tender Frame. Verify the smooth rotation of tender wheels.
3. Install 25-1 Front Step in place to 22-2 Tender Front Beam using M2-4 screws.
4. Install 25-2 Rear Step L.H. and 25-3 Rear Step R.H. in place to 22-1 Tender Frame, attaching 25-4 Rear Guard Iron L.H. and 25-5 Rear Guard Iron R.H. in place to 22-1 Tender Frame and fasten M2-4 screws to secure them.

2. Assembly of Rear Buffer

1. Insert the pin of 10-1 Buffer Head to the hole of 10-10 Buffer Stock, fitting 10-9 Buffer Spring into 10-1 Buffer Head. Attach 25-7 Rear Buffer Beam Plate to 25-6 Rear Buffer Beam and fasten 10-5 Buffer Stock Bolt into the aligned holes of 25-7 Rear Buffer Beam Plate, 25-6 Rear Buffer Beam and 10-10 Buffer Stock. Fasten 10-4 Buffer Shank to secure the rear buffer.
2. Insert the pin of 10-2 Hook Coupler into the aligned square holes of 25-6 Rear Buffer Beam and 25-7 Rear Buffer Beam Plate, slip-fitting 10-6 Coupler Spring and W-ϕ2.6 Washer to the pin of 10-2 Hook Coupler. Insert SP-ϕ1 Split Pin into the hole on the pin of 10-2 Hook Coupler and carefully bend the split pin outward to secure 10-2 Hook Coupler.
3. Install 25-2 Rear Step L.H. and 25-3 Rear Step R.H. to 22-1 Tender Frame, fitting 25-4 Rear Guard Iron L.H. and 25-5 Rear Guard Iron R.H. inside of 22-1 and fasten M2-4 screws to secure them.

4. Install 10-19 Dummy Hose in place to 25-6 Rear Buffer Beam and fasten M2-4 screws from underneath.
5. Install the above assembly of rear buffer in place to 22-1 Tender Frame using H-M2-4 hex screws.

3. Assembly of Tender Front Deck

1. Install 25-10 Tender Front Deck in place to 23-1 Tender Body fastening H-M2-4 hex screws to secure it.
2. Insert 25-8 Drawbar Pin in place to the central hole on 25-10 Tender Front Deck and 22-2 Tender Front Beam, fitting 25-9 and W-ϕ4 Washer in place.
3. Fit E-ϕ3 E-ring to the groove on 25-8 Drawbar Pin and carefully clip it with your pliers.
4. Attach 25-11 Dummy Water Pick Up and Hand Brake Handle in place to 25-10 Tender Front Deck, fitting 25-12 Dummy Water Pick Up and Hand Brake Handle to 25-11 and fasten M1.4-5 screw to secure them.

26. ASSEMBLY OF TENDER (5)

This section continues to assemble tender. Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

1. Insert the pins of 26-4 Hand Hold in place to 23-1 Tender Body and carefully bend the pins to secure 26-4 Hand Hold.
2. Install 26-5 Rear in place to 23-1 Tender Body fastening M2-4 screw from the top of 26-5 Rear Ladder and from underneath.
3. Fit PN3-1.9 O-ring to the groove of 26-7 Fuel Tank Valve Needle and fasten 26-7 to the fuel tank.
4. Apply PN7-1.9 O-ring to the thread of 26-8 Fuel Tank Cap and fasten 26-8 Fuel Tank Cap into the threaded hole on the fuel tank.
5. Fit 26-9 Water Tank Cover on 23-8 Water Tank Cover.

27. COUPLING THE LOCOMOTIVE AND TENDER

This section couples the engine and tender Locate parts and hardware necessary in advance referring to the Assembly Illustration, the Parts List and the Hardware List.

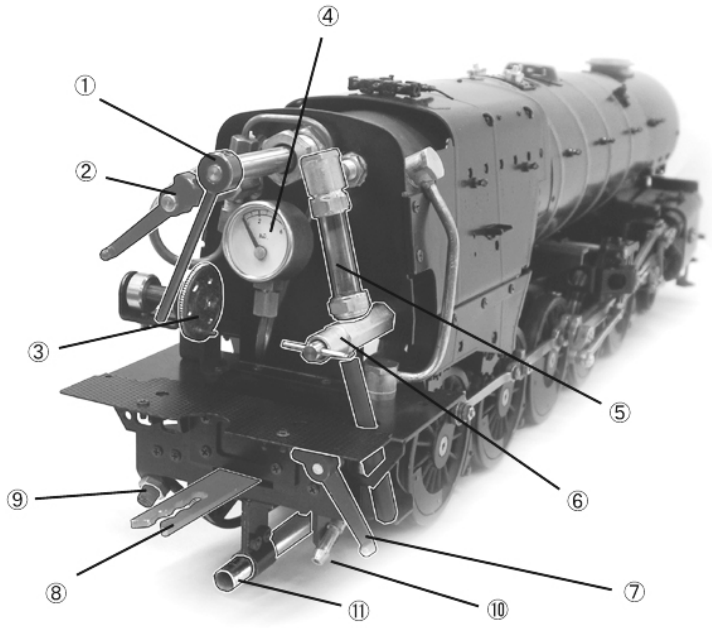
1. Cut 2 pieces of BT-ϕ5 Black Tube to measure approximately 70 mm referring to the illustration. Fit HC-1 fasteners over the ends of BT-ϕ5 Black Tube pieces. Insert 27-9 Pipe Union into 27-10 Union Nut and fit the end of BT-ϕ5 tube of 70 mm. Fasten 27-10 Union Nut to 3-9 Water Pipe from the Tender. Fit the rear end of this BT-ϕ5 tube of 70 mm to the left side of 24-3 Water Delivery Pipe. Fit the other piece of BT-ϕ5 of 70mm to the pipe of 3-4 By-pass/Check Valve Body. Fit the rear end of this BT-ϕ5 tube to the right side of 24-3 Water Delivery Pipe.
2. Cut ST-ϕ7 Silicon Tube to measure approximately 75 mm as shown. Fit one end of ST-7 silicon tube to the pipe of 21-2 Burner and the other to the pipe of 24-4 Sump.
3. Fit 27-7 Side Door in place to cab and insert 27-8 Door Pin to secure the side door.
4. Attach 27-6 Door Belt to the inside of 27-5 Side Door Rear using M1.4-3 screws. Fit 27-5 Side Door in place to 23-1 Tender Body and insert 27-8 Door Pin to secure the side door.
5. Attach 27-1 Tender Rear Plate in place to the rear side of the tender. Attach 27-2 Water Capacity Plate in place to the rear side of the tender. The correct positions to attach those plates are as shown with the illustration.

Operating Instructions

Be sure to read carefully all of these operating instructions before you operate your Aster Locomotive.

1. FUNCTIONAL DESCRIPTION

It is important for the driver to understand the function of each basic component so that optimum performance can be obtained consistently with safety. Brief descriptions are as follows;



Cab housing and Running Boards etc are not shown with above BR9F assembly to illustrate below operating devices.

Location of individual features

① Regulator Handle ② Blower Handle ③ Reverser Handle

④ Pressure Gauge ⑤ Water Gauge Glass ⑥ Blow-Down Valve

⑦ By-pass Valve ⑧ Drawbar ⑨ Feed Water Line from Tender

⑩ Water Return Line from Boiler ⑪ Fuel Line

SAFETY VALVES: (Part number 15-8. see their location in Section 15 illustration) are located on top of the boiler and prevents the boiler pressure from exceeding 4.0 Kg/cm² (4bar) during operation**.** They contain a spring loaded ball set in a housing and is installed in a threaded bush located at the top of the boiler. When boiler pressure reaches maximum working pressure, the safety valve opens, the valve spindle lifts and steam is released until a predetermined pressure drop is achieved and the spindle drops. The safety valve should he frequently checked, to assure it is not stuck shut by gently lifting up the valve spindle with tweezers.

REGULATOR: is a needle valve located on the centre of the boiler backhead. It controls the steam flow into the cylinders and governs the locomotive's speed and power. As the locomotive rolls and pitches along the track, water droplets are tossed about inside the boiler and may be picked up and held in suspension by the steam. In this condition the steam is known as wet steam and can do damage to the running gear if it should cause the cylinders to jam. To prevent this from occurring, Aster has designed the regulator to take steam from the boiler steam dome so that it picks up only dry steam.

BLOWER : This engine requires a forced draft to maintain a proper fire. The exhaust blast usually creates sufficient draft to do this while moving but when stopped, the locomotive's blower system must be activated. When the locomotive is being steamed up, an external suction fan is must be placed in the chimney so that the fire can be lit and steam raised. When the pressure in the boiler reaches to 1 to 2 kg/cm², the suction fan can be removed and the locomotive's blower system can be used to maintain the draft. It is located on the left-hand of the boiler backhead, as shown on the illustration 11 and 12.

CHECK VALVE: The check (or clack) valve provides a means of supplying water to the boiler while the locomotive is under steam. It consists of a valve body with a seat upon which rests a stainless steel ball. A water line fitting is connected to the check valve body. When the boiler is pressurized, the ball is forced tightly on its seat and steam cannot leak past it. If a water pump is connected to the filler line fitting, water can be pumped into the boiler,

since the water, which is incompressible and is being pumped in at a pressure higher than that of the boiler, forces the ball off of its seat. The check valve of this model (By-pass/ Check Valve Body, Part number 3-4) is located right-hand side below the cabin (see its location in Illustration Section 3) and is connected to valve box of the axle driven pump.

WATER GAUGE: This model is fitted with a gauge, which indicates the level of water in the boiler. For normal running a ¾ full position is recommended. When the water level is low false readings may occur, in which case be sure to add water to return to the ¾ full position. A blow down valve is also fitted which can be briefly opened when the loco is in steam to confirm water level.

BY-PASS VALVE: is a needle valve located on the right-hand side below the cab floor. It switches the flow of water between the boiler and the return water pipe to the tender. With the by-pass valve closed, water is fed into the boiler, and with it opened, water circulates between the axle pump and the tender water tank. You will learn by experience the proper setting, which will maintain the volume of water pumped into the boiler consistent with steam consumption.

CYLINDERS: The two cylinders are located on the left and right hand side of the mainframes. Their function is to convert the thermal energy contained in the steam into mechanical energy, which can be used to perform useful work. The two cylinders of BR9F class are on the angle of 6 degrees and ‘out of phase’ by 90 degrees so that the locomotive will start with the wheels in any position.

BOILER: A type "C" is used on this model and consists of a copper tube with end plates, 2 fire tubes and 1 water tube. The dia 8 mm water tube is fitted for better heating efficiency. A stainless steel firebox is fitted at the bottom of the boiler. Thermal energy from alcohol fuel converts the boiler's water into steam. A portion of the thermal energy contained in the steam is next converted into mechanical energy when the steam is expanded in the cylinders.

Aster Hobby Co. Inc strongly recommends that all Aster boilers and safety valves are hydraulically tested from time to time to ensure safe operation. If you are unsure as to how these tests are performed then your Aster Dealer or Distributor will be pleased to advise you.

BURNER: The alcohol burner is fitted at the bottom of the firebox.

PRESSURE GAUGE: The function of the pressure gauge is to show the steam pressure in the boiler. A dial type gauge is provided which connects to the boiler by means of a siphon tube and fittings.

LUBRICATOR: A Roscoe displacement lubricator is used which consists of an oil tank and a tube that connects it to the valve chest and feeds both cylinders. When the steam enters the lubricator tank, it condenses into water and sinks to the bottom of the tank. This is because a unit amount of water weighs more than an identical unit amount of oil. The oil is displaced (forced) out of the tank, through the same line by which the steam entered, and is picked up by the steam flow where it enters the cylinders and lubricates them. This process is repeated until the supply of oil is exhausted.

WATER TANK: Is located in the tender and has a water pump to feed water into the boiler when the loco is stationary.

CYLINDER DRAIN COCKS: This locomotive is equipped with working cylinder draincocks which permit the escape of water particles without damage to the piston valves when the locomotive is being started from cold. The control lever is mounted on the mainframe under the boiler and should be returned to the closed position after starting the locomotive on its run and the cylinders have warmed through.

2. PREPARATIONS FOR OPERATION

OIL: Steam cylinder oil, which can be obtained from most live steam clubs or Aster distributors and dealers, should be used in the lubricator. Straight mineral oil can be used if steam cylinder oil is not available. Do not use automobile oil since it may contain abrasives which will damage the cylinders; it may also leave deposits in the steam passages and lines which will eventually cause them to become clogged. **Light machine oil** should be used regularly to lubricate all bearings, valve motion, axles, etc.

WATER: Distilled water, manufactured by the distillation process is recommended. DO NOT USE DE-IONISED WATER AS IT MAY ATTACK FITTINGS AND SOLDERED JOINTS. Do not use tap water because it usually contains minerals, which will be deposited inside the boiler and in steam passages. A good alternative is filtered rainwater. Good water quality is extremely important for successful operation and longer life of the boiler and fittings.

FUEL: Use only anhydrous ethyl or denatured methylated alcohol which can be obtained at a scientific supply house or a Pharmacist. DO NOT USE RUBBING ALCOHOL SINCE IT CONTAINS A LARGE PERCENTAGE OF WATER AND IS TOTALLY UNSUITABLE FOR USE AS A FUEL.

Be sure to recap the supply can of alcohol as soon as possible since it will absorb water from the atmosphere and become contaminated. If the alcohol is colourless, it is a good idea to add a few drops of red food colouring to the alcohol so that it will not be accidentally mistaken for water and used to fill the boiler!

SAFETY PRECAUTIONS: THINK SAFETY FIRST, LAST AND ALWAYS WHEN OPERATING THIS LOCOMOTIVE. HAVE FIRE FIGHTING EQUIPMENT AVAILABLE PRIOR TO STEAMING UP; IT IS USUALLY TOO LATE TO SEARCH FOR IT AFTER A FIRE HAS STARTED! TO PREVENT ACCIDENTS WHICH COULD CAUSE SEVERE

INJURIES, OBSERVE THE FOLLOWING PRECAUTIONS; (1) ADD A FEW DROPS OF RED FOOD COLOURING TO THE ALCOHOL SUPPLY SO THAT IT WILL NOT BE ACCIDENTALLY MISTAKEN FOR WATER. (2) THE ALCOHOL SUPPLY SHOULD BE LABELLED "POISON' AND BE STORED IN A COOL LOCATION AWAY FROM THE IMMEDIATE VICINITY OF THE TRACK AND OUT OF THE REACH OF CHILDREN.

If alcohol is spilt when filling the tender fuel tank, move the loco and tender away from the spill and mop up thoroughly.

Live Steam operation should always be conducted OUT OF DOORS AND NEVER INDOORS.

Aster live steam models are not suitable for operation by children under the age of 16 years even with adult supervision. Children should be kept a safe distance from model steam locomotives at all time when they are being fired up and run. Sudden and unexpected emissions of scalding water and steam can cause severe injury to children. PLEASE TAKE CARE.

Have a bucket of water, wet towels and/or a spray bottle of water handy at all times to extinguish fires, which may result if the locomotive derails. It is very difficult to see and alcohol fire in direct sunlight however it is a good idea to assume that one has been started if the locomotive derails. Smother any fire with the wet towels or spray water on it until it goes out.

The safety valve on the BR class 9F model is pre-set at our factory to pop at 3.5 to 4 kg/cm^2. Do not attempt to adjust it or repair it if it is damaged. New safety valves are always available from ASTER dealers.

TRACK: Your track should be as smooth as possible on straight runs and slightly banked to the inside on all curves. This will prevent derailments and reduce the possibility of accidents.

On extremely hot days, the alcohol tank may overheat when the tender is left exposed for long hours to direct sunlight causing the fuel to vaporize and possibly start fires along the track. Wear gloves when operating and handling the locomotive. The controls on the backhead maybe hot enough to burn your fingers while raising steam and running the locomotive.

TOOLS:

Have small screw drivers, nut drivers, wrenches and pliers available to tighten any loose fasteners and to make small repairs and adjustments which may be necessary.

SPECIAL EQUIPMENT:

The following items will be necessary to service and steam the locomotive:

1. A SUCTION FAN (not provided in kit) for firing up the boiler. It is usually battery operated and sits at the top of the chimney. Aster Suction Fans are available from your Aster Dealers.
2. An OIL INJECTOR SYRINGE (provided in kit) that is used to fill the lubricator and empty distillate after the run.
3. GLOVES (not provided in kit) to protect the driver's hands.
4. A FUNNEL (not provided in kit)to pour alcohol into the fuel tank.

3. OPERATING PROCEDURES

If you have never operated a Gauge One Live Steam locomotive before, it is a good idea to have an experienced person in attendance to help with the first few runs.

(1) Lubricate all moving parts such as sliding surfaces, bearings, rods and links, using light machine oil. Silicone anti-seize lubricant can also be added.

(2) Fill the lubricator, which is located behind the front buffer beam, with steam cylinder oil using an oil syringe. Replace the filler cap and tighten it until the O ring starts to distort.

(3) Pour water in the tender water tank. Pump water into the boiler using an extension handle over the pump lever in the tender water tank until the water in gauge glass is at least ¾ full. Replenish water in the tender tank as it empties. Open the regulator before starting to pump. Close the regulator.

(4) Close the fuel tank needle valve and remove the filler cap. Fill the fuel tank with 180 ml of denatured methylated alcohol / ethyl alcohol using a clean funnel. Replace the filler cap and tighten it until the O ring starts to distort. Add a drop of oil around the O ring to assure an airtight seal. Open the fuel tank needle valve one turn and let the sump fill. Check for fuel leaks. If any are found, they must be corrected prior to lighting the fire. Most small leaks occur because the filler cap is not properly tightened.

(5) Place a small coin over one of the chimney orifices and place the suction fan in the chimney orifice and switch it on. Ignite the burner under the frame. Check the condition of the fire, using a mirror under the burner. The flame should burn predominantly blue. An alcohol fire cannot easily' be seen in bright light so it is best to light and observe the fire in the shade. If the fire burns predominantly yellow, the fuel may be contaminated and should be replaced.

(6) In a few minutes, approximately 3 in summer and 5 in winter, the pressure gauge will show a reading of 1 kglcm^2. At this point, "crack' open the locomotive's blower valve and remove the suction fan and small coin from the chimney. The pressure should continue to rise and when it reaches about 3.5 or 4 kg/cm², the safety valve will POP.

(7) Wind the reversing gear fully clockwise for forward running and open the cylinder draincocks fully. Now open the regulator slightly and push the locomotive gently forward. The driver should be wearing gloves at this stage. Hot water will be expelled from the chimney and the cylinder draincocks. **BE CAREFUL TO KEEP YOUR HANDS AND FACE CLEAR OF THE EXHAUST FROM THE CHIMNEY &**

DRAINCOCKS TO AVOID BEING BURNED. When the cylinders have been cleared, the locomotive will run smoothly and can be connected to the train.

(8) Adjust the regulator setting to suit the track and load being hauled. The blower valve should be closed when the locomotive is running unless a very heavy load is being hauled at a low speed. In this situation, it may be necessary to crack open the blower valve to maintain sufficient draft. Experience will show how to obtain optimum performance. The cylinder draincocks are usually closed during normal running

If the locomotive sounds 'hoarse' during the run then insufficient oil may be reaching the cylinders. Check the flow of oil from the lubricator.

The locomotive will run non-stop for about 20 minutes before it needs to be checked. If the regulator is set for optimum performance and the feed water by-pass valve is closed, in this ideal state, steam consumption is optimised - water is being fed into the boiler at the same rate as it is being evaporated and consumed by the cylinders. To continue the run, add more water to the tender water tank and add more fuel to the fuel tank but remember to close the fuel tank needle valve before opening the filler cap. After refilling the fuel tank and closing the filler cap, open the needle valve again.

(9) During a run keep an eye on the water gauge level and water consumption from the tender tank. If the water level goes higher than the top of the water gauge open the by pass valve for a few laps until the ¾ full position returns when the by-pass valve can be closed again.

If the engine stops, check the fire. If it is out, the fuel supply has been exhausted. Close the blower valve and fuel tank needle valve, let the engine cool for a few minutes and add fuel, oil and water as required. **IF THE FIRE IS STILL BURNING, THE WATER SUPPLY HAS BEEN EXHAUSTED. CLOSE THE FUEL NEEDLE VALVE AND EXTINGUISH THE FIRE. WHEN THE DRAFT CEASES, THE FIRE BECOMES OXYGEN STARVED AND DIES OUT ALTHOUGH THE FIRE WILL HUNT FOR OXYGEN AND MAY POP OUT**

FROM UNDER THE BOTTOM OF THE FIREBOX FOR A BRIEF PERIOD. HAVE A SPRAY BOTTLE OF WATER OR A WET TOWEL AT HAND TO EXTINGUISH ANY FIRES WHICH MAY RESULT. LET THE BOILER COOL FOR 20 MINUTES BEFORE ADDING WATER. NEVER ADD WATER TO AN OVERHEATED BOILER AS THIS COULD CAUSE SEVERE DAMAGE TO THE BOILER. After the engine has cooled, add fuel, oil and water as required.

(10) After a run and before the loco starts to cool, it is a good idea to crack open the regulator and blower valve otherwise they may 'freeze'. If this should occur NEVER force the controls open. Instead relight the fire and when working pressure has resumed the controls should 'unfreeze'.

As the locomotive is operated, it becomes "run-in' and its performance will improve. This usually takes no more than a few hours of running.

4. TROUBLE SHOOTING

When the ASTER BR Class 9F is in good operating condition, properly lubricated, provided with distilled water for the boiler, a good grade of fuel for the burner and steam cylinder oil, It can pull its maximum load of 8 or more coaches at a constant speed for about minimum 25 minutes. It will operate equally well in either forward or reverse.
Typical problems and remedies are as follows:

STEAM GENERATION PROBLEMS

If it takes more than ten minutes to generate steam to working pressure, or if the boiler pressure quickly drops during a run of a few metres and the boiler was properly filled with distilled water, proceed as follows:
Check the fuel supply for contamination. Uncontaminated fuel will burn predominantly blue. Contaminated fuel burns predominantly yellow and should be replaced.

If the problem persists, check to see that there is proper draft as follows;

a) Does the suction fan provide sufficient draft? A small fan may not be powerful enough to do the job. Use an ASTER fan and fresh batteries.

b) Are the battery leads connected to the suction fan correctly so that the fan is pulling air through the fire-box and not blowing air into the smoke-box?

c) Is the suction fan raising pressure but the locomotive's blower system is not able to maintain it, check the following

Is the blower pipe nozzle blocked?

Is the blower pipe nozzle positioned so that the nozzle discharges directly up the chimney?

Is the smoke-box door properly sealed?

REMEMBER, A FORCED DRAFT BOILER ALWAYS REQUIRES A DRAFT

A SUCTION FAN IS ALWAYS NECESSARY WHEN FIRST RAISING STEAM OTHERWISE THE FIRE WILL NOT BE SUFFICIENTLY INTENSE. ONCE STEAM IS RAISED AND THE SUCTION FAN REMOVED, THE LOCOMOTIVE'S BLOWER MUST BE CRACKED OPEN TO MAINTAIN DRAFT WHEN THE LOCOMOTIVE IS STATIONARY. DURING THE RUN, THE EXHAUST BLAST NORMALLY PROVIDES ENOUGH DRAFT TO KEEP THE FIRE BURNING BRIGHTLY. HOWEVER IF THE SPEED IS LOW AND THE LOAD HEAVY, IT MAY BE NECESSARY TO CRACK THE BLOWER VALVE OPEN SO AS TO PROVIDE ADEQUATE DRAFT WHILE RUNNING.

STEAM LEAKAGE

Slight steam leakage from piston valve devices is normal, however if the steam is continuously leaking from ends of the steam chests (Part Number 5-5) during operation, then check if the piston rings are set in grooves of the valve piston (Part Number 5-8). If a leak persists, please contact your Aster dealer and Distributor.

Check the steam lines from the regulator to the cylinders to be sure there are no loose fittings which are causing the leak. Tease out carefully the O rings in the stuffing boxes of pistons. Worn out O-rings in the stuffing boxes of pistons cause steam leakage and steam leaks can sometimes be seen coming from the gland nuts on the valves. Tighten the gland nuts and/or replace the O rings per the assembly instructions. It is normal for these glands to have slight steam leak which cannot be completely eliminated. Only if the leak is excessive, tighten the gland nut per the instructions.

The gaskets used to seal the valve covers and cylinder heads are made of paper and can easily be duplicated by cutting them a long fibre type paper. The packing compound is silicone sealant, which is available in most hardware stores. Always be careful not to use an excessive amount of sealant since it can plug steam and water passages.

UN-EVEN PERFORMANCE

If your locomotive runs better in forward than in reverse, or vice versa, check again your valve settings referring to the instructions and illustration of Section 6.
If the rotation of the wheels is stiff at front or rear dead centre, the pistons are not secured tightly to the crosshead, which may be causing the pistons to hit on either the front or rear cylinder cover.
Metal particles or foreign material in the wheel bearings will cause the wheels to seize. Clean out any foreign material and lubricate the wheel bearings using light machine oil.

CHECK VALVES

Slight leakage from the check valve filler line fitting is normal while the boiler is developing its working pressure. If the leakage continues after the boiler is developing its working

pressure and after the safety valve has popped, causing hot water to back up in the tender water tank, there may be a bit of debris on the valve ball seat which can usually be removed by pumping water into the boiler. If the ball remains stuck, remove the check valve plug and carefully extract the ball using a small screwdriver. Clean the inside of the valve body, paying special attention to the seat, and replace the ball with a new one. Add a small amount of packing compounds to the threads of the check valve plug before installing it. Be careful not to get any compound inside the valve body.

FUEL LEAKS

If the burner or fuel tank leaks from any of its joints, return it to your dealer and obtain a replacement.

5. MAINTENANCE

It is very important to keep your locomotive in good operating condition. Maintenance can be as enjoyable as operating. A well-maintained locomotive will reward you with many years of faithful service.

Key maintenance points are as follows

(1) After the day's run is completed, empty the boiler, fuel tank and lubricator and dispose of their contents in an environmentally safe manner. Refill the lubricator with fresh steam cylinder oil. If setting the locomotive aside for extended periods, it is particularly recommended that all the water is removed from the boiler by disconnecting loco from the tender, removing safety valves and empting water completely.

(2) Wipe the locomotive clean using a soft cloth so that it displays a clean "oily' gloss. Do not use cleaning solutions since they may damage the finish.

(3) Check for loose or missing fasteners and tighten/replace as necessary.

(4) Check the condition of the O-rings on the filler caps and replace them if necessary. All filler caps should be installed but not tightened.

(5) If any leaks were noted during operation, eliminate them by tightening the appropriate fittings or re-sealing with packing compound.

(6) Lubricate all moving parts with light machine oil.

(7) Leave the regulator and blower valve slightly open when storing the locomotive or they may stick shut.

(8) **VERY IMPORTANT.** Rotate the wheels of the locomotive a few turns every few weeks to assure that the pistons do not become stuck. When steam cylinder oil is cooled, it becomes more viscous and the slide valves sometimes tend to become stuck in an "Off" position.

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