WHITING
Hot Metal Ladle
Operation & Maintenance

MANUAL

Whiting

WHITING EQUIPMENT CANADA
350 Alexander Street, Welland, Ontario, L3B 2R2 - (905) 732-7585

June 1999 Edition

Section 1.0 INTRODUCTION

The purpose of this manual is to offer experienced maintenance and operating personnel an understanding of how to properly inspect, adjust, maintain, and operate Whiting manufactured hot metal ladles. It is the employers responsibility that his personnel be adequately trained in their respective fields, and have a thorough understanding of this manual before maintaining or operating this equipment.

There are many safety considerations throughout the industry for the transportation, use and maintenance of hot metal ladles. All safety hazards that can possibly arise cannot be foreseen and noted in this or other manuals. Personnel maintaining and operating this equipment must always use common sense and apply the general as well as the specific safety precautions. All employer and industry safety rules and regulations shall apply to this equipment and it's surrounding environment, along with safety rules, maintenance and operational requirements called out in this manual.

To provide a starting point for safety, maintenance and operational considerations Whiting recommends that the employer obtain a copy of the following: ANSI Z241.1, ANSI Z241.2, ANSI Z241.3, latest editions, and AISE Technical Report No. 9, latest edition. Copies of these standards can be purchased from:

(ANSI Z241)
American Foundrymen's Society, Inc.
505 State Street
Des Plaines, IL 60016
(847) 824-0181

(AISE Technical Report No. 9)
Association Of Iron And Steel Engineers
3 Stanwix St.
Pittsburgh, PA 15222
(412) 281-6323

A safety alert symbol in this manual indicates there is an important message. This symbol alerts you to the possibility of injury or death situations. Whenever this symbol **"**  **"** appears, carefully read the message that follows.

The following various notices and precautions are used throughout this manual. They are:

NOTE: **Whenever information exists, requiring additional attention beyond the standard written information, the term "NOTE" is used.**

IMPORTANT: **Whenever information exists, requiring special attention to procedures to ensure proper operation of the equipment, or to prevent its possible failure, the term "IMPORTANT" is used.**

CAUTION

Whenever potential damage to equipment exists, requiring correct procedures/practices for prevention, the term "CAUTION" is used.

WARNING

Whenever potential personal injury or death situations exist, requiring correct procedures/practices for prevention, the term "WARNING" is used.

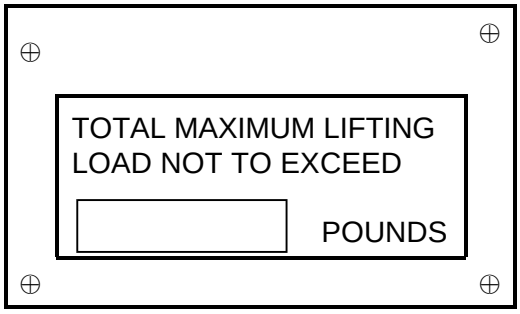
DANGER

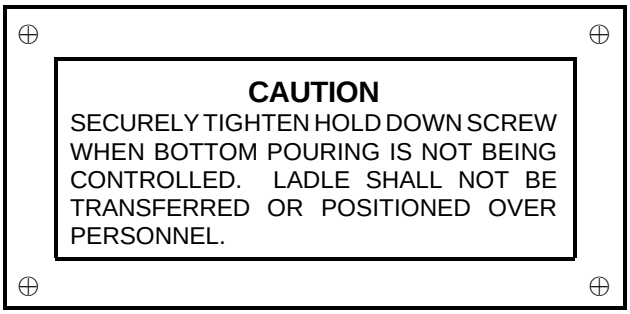
Whenever immediate hazards exist that could result in personal injury or death, which cannot be eliminated by design safeguards, the term "DANGER" is used.

Additional information on safety can be found placarded to equipment, along with additional maintenance and operation information that can be found on equipment drawings.

For technical assistance, call Whiting Corporation at (708) 596-6600.

Figure 1-1: Typical Equipment Placards are Depicted below:





For Bottom Pour Ladles

Section 2.0 SAFETY

Safety precautions and notices are intended only to supplement industry safety procedures for this type of equipment. If you are unsure about a safe operating or maintenance procedure please contact your supervisor, or contact Whiting Corporation.

The following are general operating and maintenance safety precautions for molten metal ladles. These along with specific precautions and notices will be repeated throughout this manual.

WARNING

Always wear proper eye, face or other required protection when performing maintenance. Use a hammer with a soft face, such as plastic, wood, brass or leather, when striking hardened tools or hardened metal surfaces. Not wearing the proper protection can cause injury from flying chips.

WARNING

Whenever a ladle with molten metal is NOT being used for pour, is being transported, is suspended, or is resting in a designated area, the bail lock is to be fully engaged and the operator in complete control of ladle motion. The bail lock is to be disengaged ONLY during molten metal pour. Failure to follow this procedure could allow inadvertent tilting of the ladle and create potential injury or death to the operator and surrounding personnel.

WARNING

NEVER transport a bottom tap ladle without the tapping mechanism locked. Transport with the tapping mechanism unlocked can cause leakage and spillage which can cause severe injury or death to surrounding personnel.

DANGER

Do NOT perform service or maintenance on any ladle or bail unless it is properly resting on a flat horizontal surface. Performing service or maintenance without the ladle on a flat horizontal surface, or the bail properly secured or removed, can cause personal injury or death should the ladle or bail tip over.

DANGER

The ladle is NEVER to be filled with molten metal above a level where spillage may occur during transport. Before ladle transport, an unobstructed passage for ladle transfer is to be provided, along with a smooth running transport. Failure to adhere to this could cause severe injury or death to the operator and surrounding personnel from molten metal spillage should the ladle come into contact with obstructions, or the transport not be smooth.

DANGER

Molten material transfer or pouring is NOT to be done when the molten material can come into contact with liquids such as water. Liquids such as water, when encapsulated with molten material, vaporize quickly creating high pressure. This will release energy instantaneously when the molten material touches the liquid. Molten material splatter can occur causing person injury or death to surrounding personnel.

DANGER

NEVER make alterations to the ladle, other than normal repair, without assistance and review from qualified professional personnel. Alterations to design, function, and turning effort can cause severe injury or death to the operator and surrounding personnel.

Section 3.0 OPERATION

It is **NOT** the intent of this manual to instruct personnel on how to pour molten material from the ladle. This is left to the employer and industrial standard practice. The intent is to instruct personnel on how the ladle functions so it can be operated safely.

The following topics are found in this section:

3.1 Pre-Operational Check

At the beginning of each shift the operator is to inspect or perform the following before introduction of molten metal:

1. Inspect Refractories
2. Clean Slag & Metal Splatter
3. Check Bail Lock
4. Check Tilt Gearing
5. Check Tap Rig
6. Inspect General Ladle Condition

Further descriptions of the above can be found in Section 4.0, “Maintenance.”

Along with ladle inspection before use, ladle preheating is critical for safe and reliable operation. An established refractory dry out procedure should be followed to prevent eruptions beyond the confines of the ladle during drying, preheating, and introduction of molten metal. Before operation, it is necessary to inspect the lining to insure its adequacy, perform a pre-check of ladle functions, and to thoroughly preheat the ladle lining. A long pre-heat time is recommended to avoid damage to the lining and ladle. Pre-heat should be done some time before the intended use of the ladle. Consult your refractory supplier for detailed information.

IMPORTANT:	**Ladle preheating is not only for ladle lining, but also to raise the temperature of the ladle and its components. The ladle should be allowed to “soak” the preheat, allowing for gradual thermal expansion of the ladle and its components. If the ladle and components are not allowed enough time to thermally expand, ladle component binding can occur.**
IMPORTANT:	**Prior to preheating the ladles for rack type tap rigs the gooseneck and slide assembly with rack are to be removed from the rig. For 5-position tap rigs only the gooseneck is to be removed. Refer to Section 4.8, “Tap Rig Instructions” for removal procedure.**

A ladle is **NOT** to be placed in service if:

1. Refractories are cracked or sections missing.
2. Bail lock is **NOT** functional or missing.
3. Ladle is hard to turn.
4. Ladle shell, bail, or bail loop are damaged.
5. Refractories have not been properly pre-heated and moisture removed.
6. Ladle has not been allowed enough time to “soak” pre-heat.
7. All conditions resulting from wear or damage including irregular or misaligned components have not been thoroughly checked and corrected.

3.2 Operation

3.2.1 Safety

DANGER

The ladle is NEVER to be filled with molten metal above a level where spillage may occur during transport. Before ladle transport, an unobstructed passage for ladle transfer is to be provided, along with a smooth running transport. Failure to adhere to this could cause severe injury or death to the operator and surrounding personnel from molten metal spillage should the ladle come into contact with obstructions, or the transport not be smooth.

DANGER

Molten material transfer or pouring is NOT to be done when the molten material can come into contact with liquids such as water. Liquids such as water, when encapsulated with molten material, vaporize quickly creating high pressure. This will release energy instantaneously when the molten material touches the liquid. Molten material splatter can occur causing person injury or death to surrounding personnel.

If the ladle is to be attached to an overhead crane, refer to the crane operators manual and OSHA standards for overhead cranes. Confirm that the crane meets capacity needs and hot metal service requirements. Verify proper and full engagement of the ladle bail to the crane hook or other crane attachment devices. If a detachable bail is used, confirm full and proper engagement of the bail to the ladle by “floor level” observation.

When a ladle containing molten metal is being transported, all personnel must be cleared from the path of movement and warning devices on the crane or other material handling devices must be sounded continually. Make sure the ladle is clear from contact with obstructions and other moving devices or equipment. Travel must be at a low speed so an emergency stop will not result in a metal spill.

WARNING

Whenever a ladle with molten metal is NOT being used for pour, is being transported, is suspended, or is resting in a designated area, the bail lock is to be fully engaged and the operator in complete control of ladle motion. The bail lock is to be disengaged ONLY during molten metal pour. Failure to follow this procedure could allow inadvertent tilting of the ladle and create potential injury or death to the operator and surrounding personnel.

CAUTION

Never rotate the bail over with just the gearing. Bail rotation using only the gearing produces higher than design torque on the drive trunnion that can cause keyway failure and / or tipping of the ladle. Always use a crane to hold the weight of the bail during rotation of the bail.

CAUTION

The gross load rating of the bail is never to be exceeded or damage to equipment can occur.

3.2.2 Manual Tilt Gearing Operation

The direction of handwheel rotation controls the direction of tilt. Clockwise handwheel rotation rotates the ladle clockwise, and counterclockwise handwheel rotation will rotate the ladle counterclockwise. Before tilting, the manual bail lock is to be released.

WARNING

Whenever a ladle with molten metal is NOT being used for pour, is being transported, is suspended, or is resting in a designated area, the bail lock is to be fully engaged and the operator in complete control of ladle motion. The bail lock is to be disengaged ONLY during molten metal pour. Failure to follow this procedure could allow inadvertent tilting of the ladle and create potential injury or death to the operator and surrounding personnel.

The ladle tilt gearing, whether "E-Z Pour" or "Fingertip," includes a standard brake. In conjunction with a properly maintained gear set the brake is designed to retard the ladle from turning unless the handwheel is turned.

IMPORTANT: For "E-Z Pour" tilt gearing the brake shoe must be installed and properly maintained at all times for the mechanism to function. For "Fingertip" tilt gearing proper lubrication, lubricant cleanliness, and brake surface finish must be maintained at all times for the mechanism to function.

Mechanical life of the tilt gearing is preserved by automatic lubrication. Each time the handwheel is turned, an internal pump automatically forces oil to moving parts. This automatic lubrication feature substantially lengthens the life and operational efficiency of gears and bearings.

The model L1422 "E-Z Pour" tilt gearing requires the operator to activate a one shot lubrication pump prior to initial ladle use. This operation provides sufficient lubrication at the upper worm until the internal automatic pump can supply the lubrication.

IMPORTANT: The one shot lubricator on the model L1422 "E-Z Pour" ladle tilt gearing must be used prior to each initial ladle use. Failure to do so will increase gearing wear and increase handwheel turning effort.

3.2.3 Motorized Tilt Gearing Operation

The direction of ladle rotation is dependant upon the wiring and labeling of the motor controls. Care should be taken when making control selection for the intended direction of ladle rotation. If you are unsure of control selection and ladle rotation, contact your supervisor or refer to the electrical drawings. Before tilting, the manual bail lock is to be released.

WARNING

Whenever a ladle with molten metal is NOT being used for pour, is being transported, is suspended, or is resting in a designated area, the bail lock is to be fully engaged and the operator in complete control of ladle motion. The bail lock is to be disengaged ONLY during molten metal pour. Failure to follow this procedure could allow inadvertent tilting of the ladle and create potential injury or death to the operator and surrounding personnel.

Motorized tilt gearing is equipped with a motor mounted disc brake. When a tilt direction is selected, the brake automatically releases. To stop tilting, release the selection for the brake to automatically engage.

DANGER

Do NOT operate motorized ladles without a brake. If the brake has been removed, consult Whiting Corporation for replacement. Operating a motorized ladle without a brake could allow uncontrolled tilting of the ladle that can cause severe injury or death to the operator and surrounding personnel.

In the unlikely event of a power failure, the motorized gearing is provided with a means to release the motor brake. Refer to ***Figure 3-1*** for location of release. Should a power failure occur and the ladle require tilting for safety purpose, perform the following steps.

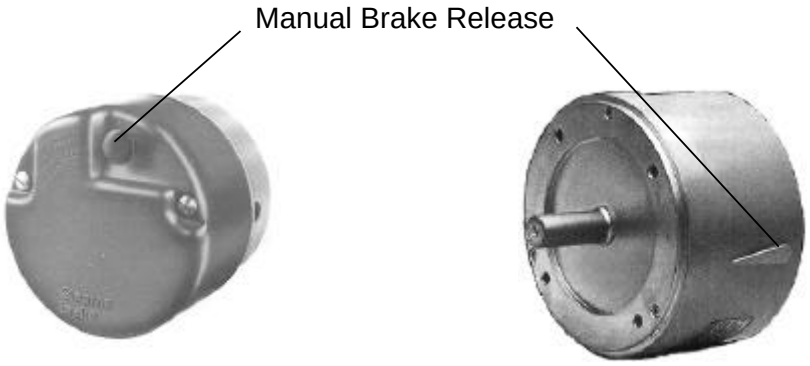
WARNING

TWO people are required to manually operate the motorized ladle. One person is to operate the temporary handwheel while the second releases the motor brake. Failure to use two people could allow for uncontrolled tilting of the ladle during brake release that can cause injury or death to the operator and surrounding personnel.

1. Disconnect the power from the motor.
2. Install the temporary handwheel.
3. While one person has control of the handwheel and ladle motion, a second person is to manually release the brake.
4. Turn the handwheel for the direction of tilt, i.e., clockwise to rotate the ladle clockwise or counterclockwise to rotate the ladle counterclockwise.

Whenever the ladle is not rotated the brake is to be set.

Figure 3-1: Motor Mounted Disc Brake



Type I **Type II**

3.3 Work Area

Floors in pouring areas shall utilize materials which minimize molten metal splatter and eruptions during metal transfer and/or pouring operations. A means such as pits, curbs and/or procedures shall be provided to guard personnel from molten metal in the event of a runout or spill. Areas that are provided to receive runouts or spills shall be kept free from accumulations of liquids and combustibles.

DANGER

Molten material transfer or pouring is NOT to be done when the molten material can come into contact with liquids such as water. Liquids such as water, when encapsulated with molten material, vaporize quickly creating high pressure. This will release energy instantaneously when the molten material touches the liquid. Molten material splatter can occur causing person injury or death to surrounding personnel.

3.4 Protective Clothing Requirements

Flame retardant clothing is to be worn when working with or around hot metal ladles. When exposure to molten metal will be extreme such as pouring large castings, then heavy flame retardant splash coats, hard hats, face shields, eye protection, heavy gloves, leather leggings and metatarsal shoes are to be used in addition to the flame retardant clothing.

3.5 Ladle Fill

The ladle is NEVER to be filled over the capacity that it has been designed for. In addition, the gross ladle weight is NOT to exceed the rated capacity of the lifting bail or bail loop. Adequate top allowance (freeboard) is to be given so that molten metal spillage will NOT occur during ladle transfer.

CAUTION

The gross load rating of the bail is never to be exceeded or damage to equipment can occur.

DANGER

The ladle is NEVER to be filled with molten metal above a level where spillage may occur during transport. Before ladle transport, an unobstructed passage for ladle transfer is to be provided, along with a smooth running transport. Failure to adhere to this could cause severe injury or death to the operator and surrounding personnel from molten metal spillage should the ladle come into contact with obstructions, or the transport not be smooth.

WARNING

Whenever a ladle with molten metal is NOT being used for pour, is being transported, is suspended, or is resting in a designated area, the bail lock is to be fully engaged and the operator in complete control of ladle motion. The bail lock is to be disengaged ONLY during molten metal pour. Failure to follow this procedure could allow inadvertent tilting of the ladle and create potential injury or death to the operator and surrounding personnel.

Section 4.0 MAINTENANCE

Proper inspection and maintenance is required on a regular basis to ensure the ladle is safe for operation. Maintenance, as called out in this section of the manual, is considered the minimum requirement. It is the employers responsibility to increase the intervals to fit the duty cycle.

IMPORTANT: **The following items of planned maintenance is considered the minimum amount of maintenance required for an eight hour per day, five days per week operation. For more frequent use the schedule is to be increased. This is a schedule for planned maintenance only, and is NOT intended to replace common industrial practice, i.e., daily visual inspection. At all times, both operation and maintenance personnel are to be aware of the equipment condition and take appropriate action to correct problems immediately.**

DANGER

NEVER make alterations to the ladle, other than normal repair, without assistance and review from qualified professional personnel. Alterations to design, function, and turning effort can cause severe injury or death to the operator and surrounding personnel.

The following topics are found in this section:

A “Planned Maintenance Schedule”, Section 4.1, is provided as a guide to what inspections or checks are required on a scheduled basis. Instructions on how to perform the maintenance are found in the following Section 4.2, “Details of Planned Maintenance.” For reference purpose, both sections are in the same numerical sequence.

NOTE: **When tightening capscrews always use the proper torque. Reference Section 5.0, “Additional Information,” for values if they have not been already established by the employer.**

WARNING

Inspection and maintenance should be performed on cool ladles to prevent possible injury from burns.

Occasionally ladle parts will become distorted from uneven pre-heating or direct radiant heat from the pouring process. This can cause mechanical bind. If this occurs, proper pre-heat of the equipment and the addition of heat deflection devices are to be applied by the customer, after approval by Whiting Corporation.

IMPORTANT: **Ladle preheating is not only for ladle lining, but also to raise the temperature of the ladle and its components. The ladle should be allowed to "soak" the preheat, allowing for gradual thermal expansion of the ladle and its components. If the ladle and components are not allowed enough time to thermally expand, ladle component binding can occur.**

DANGER

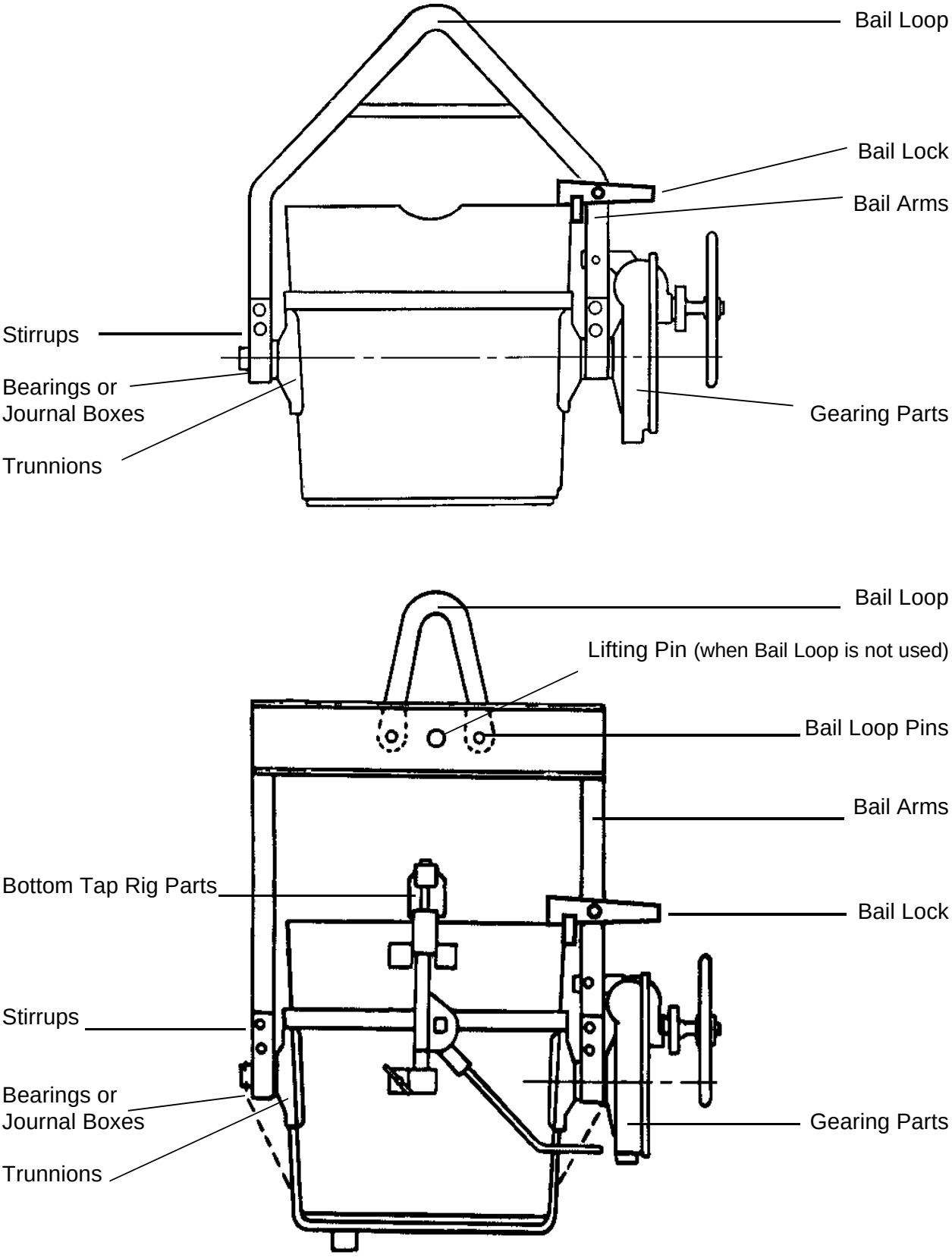
<u>NEVER</u> make alterations to the ladle, other than normal repair, without assistance and review from qualified professional personnel. Alterations to design, function, and turning effort can cause severe injury or death to the operator and surrounding personnel.

The following components are to be replaced, not repaired, if they are found worn or damaged. Refer to ***Figure 4-1***.

Bail Lock
Bail Loop or Lifting Pins
Bail Loop Pins
Bail Arms
Stirrups
Bearings or Journal Boxes
Trunnions
Gearing Parts
Bottom Tap Rig Parts
Floating Coupling Parts (NOT ILLUSTRATED)

Secondary components like bands and spacers, that are subject to wear or corrosion, are to be replaced if they are less than 75% of the original size. The ladle shell itself is to be repaired or replaced if wear or cracks are found. Any weld repair is to be done by certified welders using full penetration welds.

Figure 4-1: Typical Ladle Components



4.1 Planned Maintenance Schedule

NOTE: When planning and performing planned maintenance, plan and perform all earlier time schedules, i.e., for "Every 6 Months" both the "Each Shift" and "Each Reline" are to be included in the "Every 6 Month" schedule.

Chart 4-1: Planned Maintenance Schedule

Ref.	Component/System	Each Shift	Each Reline	Every 6 Months	Yearly	Service/Check/Adjust
4.1.1 Bowl						
1a.	Refractory	X				Inspect, Patch, Replace
1b.	Slag & Metal Splatter	X				Remove
1c.	Bail Lock & Gearing	X				Check Operation
1d.	Trunnions	X				Check End Caps and Bolts
			X			Visually Inspect for Damage
				X		Inspect, Measure Diameter
1e.	Shell	X	X			Inspect for Damage
		X	X			Inspect for Wear, Corrosion
					X	Inspect Welds
1f.	Tilt Lug				X	Inspect, Measure Cross Section

Chart 4-1: Planned Maintenance Schedule (cont'd.)

Ref.	Component/System	Each Shift	Each Reline	Every 6 Months	Yearly	Service/Check/Adjust
4.1.2 Bail						
2a.	Bail Loop	X				Inspect Cotter Pins
				X		Inspect Wear
					X	Measure Cross-Section
2b.	Bail Arms (bar type)	X				Visual Inspect
				X		NDT Inspect
2c.	Bail Arms (detachable)	X				Visually Inspect Arms
				X		Visual Inspect Wear Liners (hook type)
				X		Visually Inspect Welds (hook type)
				X		Visual Inspect Rivets (hook type)
2d.	Headbeam		X			Visual Inspect Bolts and Beam
2e.	Bail, V-Type	X				Visual Inspect
				X		NDT Inspect, Measure Cross-Section
2f.	Bail Lock	X				Check Function
			X			Inspect, Lubricate
2g.	Stirrups	X				Visual Inspect Stirrups
			X			Inspect, Tighten Bolts
				X		NDT Inspect
2h.	Journal Box Bearings		X			Lubricate
					X	Clean, Visual Inspect
2i.	Anti-Friction Bearings		X			Lubricate
					X	Clean, Visual Inspect

Chart 4-1: Planned Maintenance Schedule (cont'd.)

Component/System	Each Shift	Each Reline	Every 6 Months	Yearly	Service/Check/Adjust
4.1.3 Gearing					
"E-Z Pour" & "Fingertip"	X				Check Brake Operation
"E-Z Pour"	X				Check Handwheel End Play
"E-Z Pour" & "Fingertip"	X				Check Oil Level
"E-Z Pour" & "Fingertip"	X				Inspect for Damage
"E-Z Pour" & "Fingertip"		X			Check for Movement
"E-Z Pour" & "Fingertip"		X			Check for Leaks
"E-Z Pour" & "Fingertip"		X			Check Oil Flow
"E-Z Pour"		X			Inspect Brake Area, Degrease
"E-Z Pour" & "Fingertip"				X	Clean Pump, Change Lubricant
4.1.4 Tap Rigs					
Rack, 5-Position, Steel Mill	X				Remove Slag, Check Operation
Rack, 5-Position, Steel Mill		X			Clean, Lubricate Adjustments
Rack, 5-Position, Steel Mill				X	Disassemble, Inspect, Clean

4.2 Details of Planned Maintenance

IMPORTANT: The following items of planned maintenance is considered the <u>minimum</u> amount of maintenance required for an eight hour per day, five days per week operation. For more frequent use the schedule is to be increased. This is a schedule for planned maintenance only, and is <u>NOT</u> intended to replace common industrial practice, i.e., daily visual inspection. At all times, both operation and maintenance personnel are to be aware of the equipment condition and take appropriate action to correct problems immediately.

WARNING

Inspection and maintenance should be performed on cool ladles to prevent possible injury from burns.

4.2.1 Bowl

1a. Refractory

Each Shift: Inspect ladle refractories each shift and patch or replace as required. In addition, during each use of the ladle, the operator is to observe refractory integrity. If refractory failure is eminent, even during operation, the ladle is to be immediately taken out of service and the refractory repaired.

1b. Slag & Metal Spatter

Each Shift: All safety and operational components of the ladle are to be kept free of slag and metal spatter build up. These components include, but are not limited to the bail lock, brake drum and hand wheel. Slag should always be removed when it is effecting the function or balance of the ladle.

1c. Bail Lock and Gearing

Each Shift: Check that the bail lock fully engages, and that the bail lock and gearing are functioning properly before operation.

1d. Trunnions

NOTE: Trunnion shafts that utilize anti-friction roller type bearings are normally not subject to wear when properly maintained, hence, trunnions may not require changing over years of operation.

Each Shift: Trunnion end caps are to be checked for full engagement, tightness and damage. If not properly engaged it is to be corrected or replaced. If the end caps or cap screws are damaged they are to be replaced.

Each Reline: During each reline the trunnions are to be visually checked for damage, distortion, or cracks. If cracks are suspected further inspect by magnetic particle, ultrasonic, or dye penetration test methods. If damage, distortion, or cracks are found, the trunnions are to be replaced.

Trunnions having wearable sleeves are to have the sleeves replaced when worn 75% of their original thickness.

6 Months: Caliper the trunnion diameter at 45^{o} intervals for comparison to predetermined standards. If less than allowed, replace the trunnions.

Inspect by magnetic particle, ultrasonic, or dye penetration test method. If cracks are suspected or found replace the trunnion.

1e. Shell

Each Shift: Visually inspect for wear, corrosion, or damage. Repair or replace damage before placing into service. Any weld repair is to be done by certified welders using full penetration welds.

Each Reline: Thoroughly inspect for wear, corrosion, or damage. Any weld repair is to be done by certified welders using full penetration welds.

Yearly: Thoroughly inspect for defects and cracks in material. Dye penetrate inspect welds. Repair as required. Any weld repair is to be done by certified welders using full penetration welds.

1f. Tilt Lug

Yearly: Caliper the tilt lug section for comparison to predetermined standards. If less than 85% of the original cross-section the tilt lug is to be replaced.

4.2.2 Bail

2a. Bail Loop

Each Shift: Visual check cotter pins at the bail loop attach pins. Missing or damaged cotter pins are to be replaced before placing the ladle into service.

6 Months: Visual inspect bail loop and attach pins for wear or damage. The bail loop and attach pins are to be replaced if damaged or if any abnormal or excessive wear is found.

Magnetic particle, ultrasonic, or dye penetration inspect the bail loop and attach pins for cracks. Replace if cracks are found.

Yearly: Caliper the bail loop cross-section for comparison to predetermined standards. If less than 85% of the original cross-section the bail loop is to be replaced.

2b. Bail Arms (bar type)

Each Shift: Visually inspect for damage and straightness. Replace if damaged or bent.

6 Months: Inspect by magnetic particle, ultrasonic, or dye penetration methods to determine cracks. Replace if cracks are found.

NOTE: For rolled steel bar arms, do not confuse roll marks with cracks. Inspection and evaluation should only be performed by a certified inspector.

2c. Bail Arms (detachable)

Each Shift: Visually inspect for damage and straightness. Replace if damaged or bent.

6 Months: Visual inspect wear liners for hook type detachable arms. Replace wear liners when worn 75% of their original thickness. Follow AISE recommended procedures when making repairs.

Visual inspect welds for damage and cracks using dye penetration. Repair welds per AISE recommended procedures.

Visual inspect rivets for tightness and form. Tighten or replace any that are loose or damaged.

2d. Headbeam

Each Reline: Inspect attachment bolts. Loose bolts are to be tightened to proper specification. Replace bolts that are damaged or will not tighten.

Inspect headbeam for damage. Replace if damaged. Other damaged components, i.e., attach plates, can be repaired or replaced.

2e. Bail Arms (V-type)

Each Shift: Visually inspect for damage and straightness. Replace if damaged or bent.

6 Months: Inspect by magnetic particle, ultrasonic, or dye penetration methods to determine cracks. Replace if cracks are found.

NOTE: For rolled steel bar arms, do not confuse roll marks with cracks. Inspection and evaluation should only be performed by a certified inspector.

2f. Bail Lock

Each Shift: Inspect the bail lock for proper operation. Remove slag or other foreign material that will keep the bail lock from fully engaging.

WARNING

Whenever a ladle with molten metal is NOT being used for pour, is being transported, is suspended, or is resting in a designated area, the bail lock is to be fully engaged and the operator in complete control of ladle motion. The bail lock is to be disengaged ONLY during molten metal pour. Failure to follow this procedure could allow inadvertent tilting of the ladle and create potential injury or death to the operator and surrounding personnel.

Each Reline: Visual inspect for damage and replace components as required. Lubricate the pivot area as called for in Section 4.3, "Lubrication."

2g. Stirrups

Each Shift: Visual inspect for damage or cracks. If cracks are suspected, further inspect by magnetic particle, ultrasonic, or dye penetration test methods. If damaged or cracks are present, replace the stirrups.

Each Reline: Inspect and tighten stirrup bolts. If bolts are damaged or will not tighten to proper specification, replace the bolts.

6 Months: Remove the stirrups and inspect for damage. Inspect for cracks by magnetic particle, ultrasonic, or dye penetration test methods. If damage or cracks are present, replace the stirrups.

2h. Journal Box Bearings

Each Reline: Lubricate using recommended lubricant called out in Section 4.3, "Lubrication."

Yearly: Clean and visually inspect for wear. Replace if worn. Excessive wear is when a $^{1}/_{8}$" gap exists between the trunnion diameter and journal box bore.

2i. Anti-Friction Bearings

Each Reline: Lubricate using recommended lubricant called out in Section 4.3, "Lubrication."

Yearly: Remove, clean, and inspect bearings. Replace as required.

4.2.3 Tilt Gearing

NOTE: Refer to Whiting Bulletins FL-101 for "E-Z Pour," and FL-102 for "Fingertip," latest revisions, for detailed information on operation and maintenance.

Each Shift: Determine if the brake assembly operates freely and sets when the handwheel is not rotating. With the ladle empty and suspended by the bail, remove the bail lock and rotate the handwheel approximately four (4) revolutions in both directions. If hard to turn or the brake does not set when the handwheel is stopped, disassemble the brake and inspect.

WARNING

Before disassembly of the brake, the ladle is to be resting on the ground. The bail lock is to be properly engaged and tied down to prevent its release. Failure to fully engage and secure the bail lock before disassembly of the brake can cause personal injury or death should the bail turn over.

Check handwheel end play on "E-Z Pour" tilt gearing only. End play should be at least $^{1}/_{16}$". If not present, remove handwheel, inspect, and repair.

Check oil level. If not at the proper level, add the recommended lubricant called out in Section 4.3, "Lubrication." Check for oil leaks and repair as required.

Visually inspect the tilt gearing for damage. Repair or replace as required.

Each Reline: Check tilt gearing for movement on the trunnion. The tilt gearing is to be rigidly mounted. Movement indicates worn parts that will require replacement.

Check for leaks. Correct leaks and add the recommended lubricant called out in Section 4.3, "Lubrication."

Check oil flow. With the ladle cool and suspended from the bail, observe for oil flow when the handwheel is turned. If oil flow is not present, disassemble and repair the pump mechanism.

Inspect the brake shoe for "E-Z Pour" gearing. If worn replace with authorized brake shoe. Remove any foreign material. If oil is found, check the shaft seal and replace if required. Degrease the brake drum using a non-flammable solvent and inspect for wear. Replace as required. Check that the brake drum is properly secured to the gear case by the set screws.

DANGER ⚠

<u>NEVER</u> place a ladle in service that does not have a brake, and only use factory authorized brakes. Failure to install a brake, or use of an unauthorized brake (and material), could result in personal injury or death.

Yearly: Remove the oil and pump. Clean the pump and check for proper operation. Repair or replace as required. Install fresh lubricant called out in Section 4.3, "Lubrication."

4.2.4 Tap Rig

Each Shift: Remove slag and check that the mechanism operates freely. Repair as required.

Each Reline: Remove the clamp screw and adjust the nut. Clean and lubricate. Use the recommended lubricant called out in Section 4.3, "Lubrication."

Yearly: Remove, disassemble, and inspect for wear. Repair or replace as required. Lubricate with the recommended lubricant called out in Section 4.3, "Lubrication."

4.3 Lubrication

Good lubrication procedures are important in order to keep equipment in proper working order. In most cases equipment drawings indicate the lubrication points, recommended lubricant and lubrication frequency.

Where recommended lubricants are given, it is not a guarantee to the performance of the lubricant. Always consult the lubricant supplier for proper application of the lubricant.

Refer to the illustrations in Section 4.4, “Maintenance and Lubrication Illustrations,” for locations of these lubrication points.

Chart 4-2: Lubrication

Ref.	Component	Schedule	Lubricant	Application	Quantity
A	Journal Box Bearings	Each Reline	Mobilith SHC 220	Pressure Gun	As Required
B	Anti-Friction Bearings				
C	Tilt Gearing	Check Each Reline Change Yearly	E.P. 90	Pour	L1010 - 3 Qt. L992 - 3 Qt. L1016 - 4 Qt. L1040 - 4 Qt. L1422 - 3 Gal.
			Mobil Fluid 350		#2 Fingertip - 2 Qt. #3 Fingertip - 2 Qt. #4 Fingertip - 3 Qt.
D	Bail Lock	Each Reline	FelPro C300	Hand Spray	As Required
E	Cover Hinges				
F	Key				
G	Lock Screw				
H	Adj. Screw				
I	Swivel				
J	Slide				

4.4 Maintenance and Lubrication Illustrations

Refer to Section 4.1, "Planned Maintenance Schedule" and Section 4.3, "Lube Chart." References used in these sections correlate to the references on these illustrations.

NOTE:	**References with both a number & lower case letter refer to the Planned Maintenance Schedule. References with only a capital letter refer to the Lube Chart**.

Figure 4-2: Lip Pour Ladle, Geared, V-Type Bail w/Cover and Sleeve Type Bearings, Cast Steel Trunnion Bases.

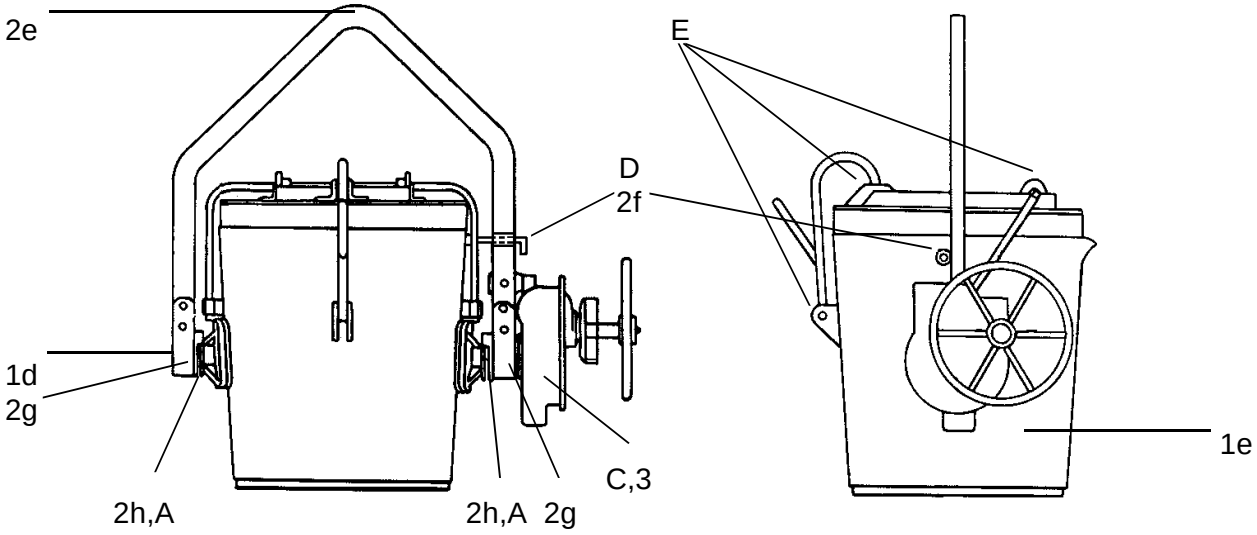
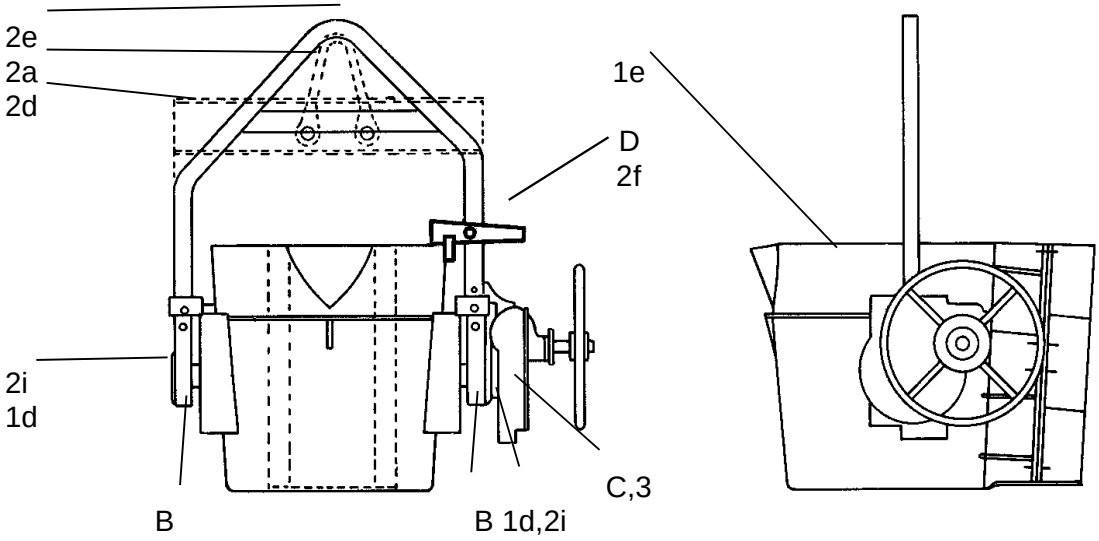


Figure 4-3: O.T.S (Outside Teapot Spout) Ladle, Geared, V-Type or Square Type Bail, Anti-Friction Bearings, Air Cooled Trunnions.



4.4 Maintenance and Lubrication Illustrations (continued)

Refer to Section 4.1, “Planned Maintenance Schedule” and Section 4.3, “Lube Chart.”

Figure 4-4: Rack Type Tap Rig

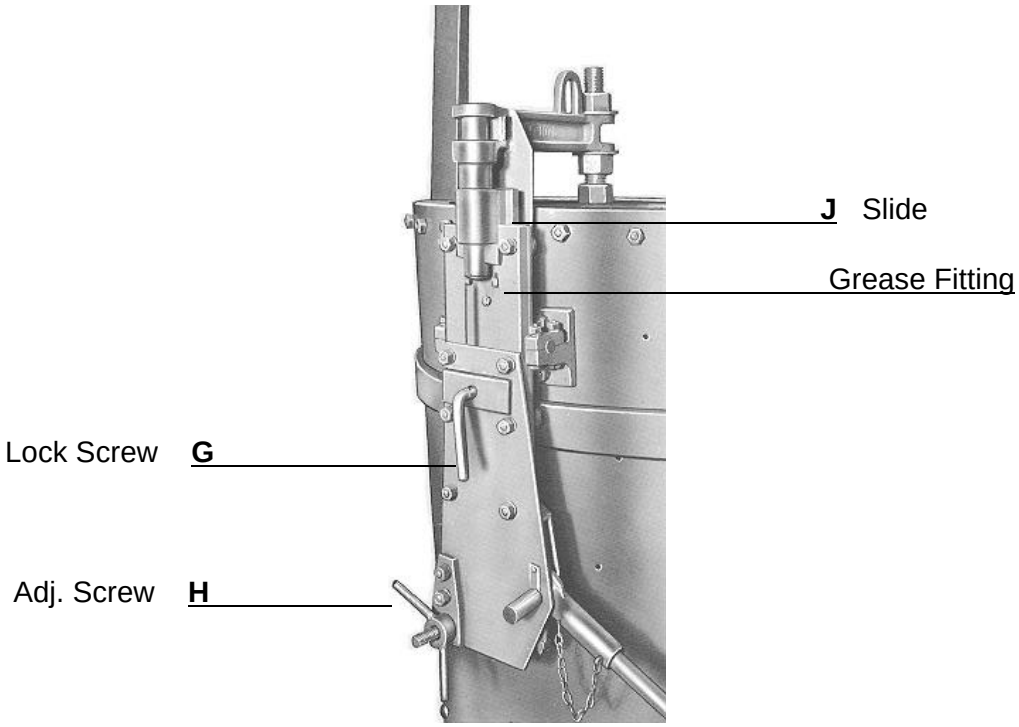
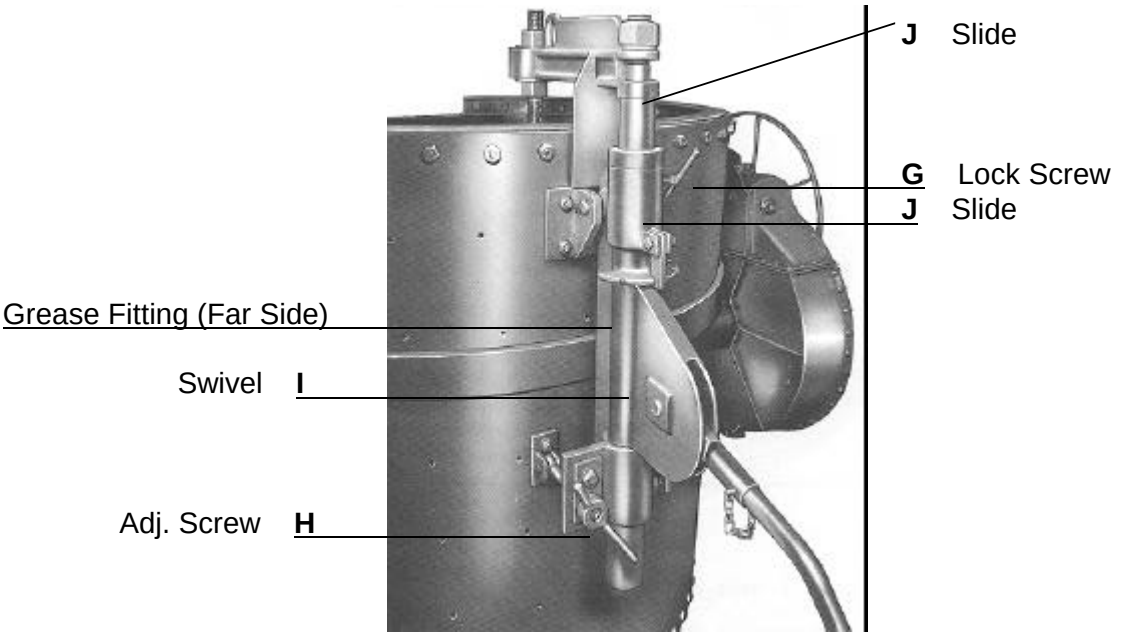


Figure 4-5: Five Position Type Tap Rig



4.5 Trunnion Replacement

After long periods of use the trunnions may require replacement. Replacement can be accomplished in two ways. Either the trunnions can be cut off and the bases line bored oversized (consult Whiting prior to this option) for the new trunnion shafts, or new trunnion and base assemblies can be field mounted. If the latter method is used, care must be taken to assure good alignment.

Some ladles, i.e., bottom tap and teapot spout ladles, are built for one direction of pour and require offset trunnions. (Offset from centerline of ladle.) Field conversion to an opposite hand pour can be accomplished by mounting a new set of trunnion and base assemblies that have been arranged for the direction of pour. The proper position (offset) can be found on the equipment arrangement drawings.

Good trunnion alignment is necessary for proper operation of the ladle and long trunnion and bearing life. The following procedure can be used to align the trunnion shafts. Normally the ladle is set in its upright position on a flat bed plate provided that the bottom is flat. If the bottom is distorted, the ladle can be placed on a flat bed plate with the top side down. Before conversion or replacement of trunnions, the ladle is to be stripped of its refractories and inspected. Ladle components are to be inspected per Section 4.2, “Planned Maintenance.”

Trunnion and base installation:

1. Bolt the trunnion assemblies in place at the four outer corners.
2. With the use of an alignment tool, similar to that shown in ***Figure 4-7***, check the alignment of the trunnions at two intervals that are 90^{o} apart.
3. Place shims under the trunnion base until the trunnions shafts are aligned in the two intervals of item 2 above.
4. After shimming is complete, remove the bolts one at a time while replacing each bolt with the recommended “Huck” fastener. (Refer to ***Figure 4-10*** for typical “Huck” fastener installation.)
5. Finish installation of the remaining fasteners.

Figure 4-6: Tool on Parallel Plane

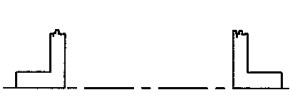


Figure 4-7: Tool Over Trunnions

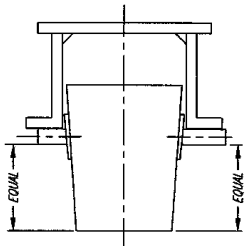
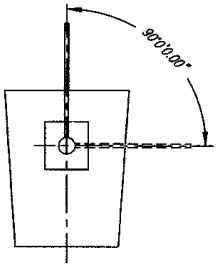


Figure 4-8: Tool At 90° Interval



NOTE: Trunnion Alignment Tool <u>MUST</u> be parallel and on the same plane.

Prior to 1980 trunnion bases were attached to the ladle shell using cold formed rivets. After 1980 Huckbolt®[1] fasteners were used, and are currently in use today. The use of fasteners, i.e., rivets and Huckbolts, allow the trunnion and base to be field removed and installed.

The figures below show the truss head Huck Fastener and round head Huck Fastener. Typically truss head fasteners are used, shown in ***Figure 4-9***, for low profile to allow for close bricking of the ladle. Round head fasteners can be substituted, shown in ***Figure 4-10***, when truss head fasteners are not available.

Figure 4-9: Truss Head Huck Fastener

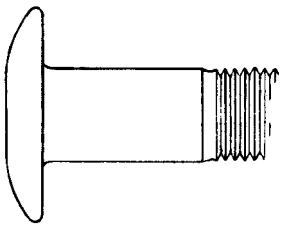
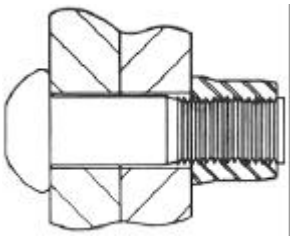


Figure 4-10: Installed Round Head Huck Fastener



IMPORTANT: Follow the manufacturers recommendations and procedures for installation of the Huck Fastener.

Huck Fasteners and installation tools can be obtained from:

Huck Manufacturing Company
8117 Imperial Drive
Waco, Texas 76710
Phone: (254) 776-2000
Phone: (800) 388-4825
Fax: (254) 751-5259

For ladles using cold form rivets, the rivets can be re-set to tighten, or replaced with the appropriate Huck Fastener.

[1]Huckbolt is a registered trademark of Huck Manufacturing Company.

4.6 Bearing Replacement

4.6.1 Removal

If force must be used to dismantle a mounted bearing, it should be applied to the ring which has the tighter fit. If the force needs to be applied to the opposite ring, the bearing should be pulled in increments while rotating the bearing between increments. This is to avoid damage to the tracks or rolling elements. Care should always be taken to apply a steady well distributed pull to the bearing during removal. A steady pull by means of a press or puller is least likely to damage the bearing.

In cases where it is difficult to remove the bearing, even with a puller, hot oil or dry ice can be used on the bearing along with the puller. The expansion or shrinkage of the bearing should happen before the shaft or housing, allowing a short time for removal. On large bearings, the shaft may be provided with oil holes and grooves for the purpose of hydraulic removal. The use of a rod and hammer to drive off a bearing or cutting off a bearing should only be used as a last resort.

WARNING

Always wear proper eye, face or other required protection when performing maintenance. Use a hammer with a soft face, such as plastic, wood, brass or leather, when striking hardened tools or hardened metal surfaces. Not wearing the proper protection can cause injury from flying chips.

4.6.2 Assembly

Care should be taken when assembling bearings on shafts, or in housings, to avoid damage to components. Bearing drivers are recommended wherever possible. Care must be taken to see that the cage or oil seals are not damaged. Relatively small bearings can be conveniently assembled by a hand press acting on the tight race. In some cases it may be necessary to use a hollow tube placed against the bearing ring and hammer the bearing home. In extremely tight fits, the bearing may be heated by an infrared lamp or a hot oil bath in order to allow an easier fit over a shaft. The temperature of the bearing should be held below 300^{o}F. If the outer race is the tighter fit, dry ice may be used to shrink the bearing or the housing may be heated. Care must be taken when these methods are required.

4.7 Gearing Replacement

Refer to Whiting Bulletins FL-101 for “E-Z Pour” gearing and FL-102 for “Fingertip” gearing, latest editions.

4.8 Tap Rig Instructions

4.8.1 Rack Type Tap Rigs

4.8.1.1 Preheating Instructions

Prior to ladle preheating, the gooseneck and slide assembly with rack are to be removed from the rig. Refer to ***Figure 4-11*** and perform the following steps for removal.

IMPORTANT:	**Prior to preheating the ladles for rack type tap rigs the gooseneck and slide assembly with rack is to be removed from the rig. For 5-position tap rigs only the gooseneck is to be removed.**

Step:

1. Swing the sector pin retainer plate out of the way and remove the sector pin (item 7).
2. Disengage the sector (item 2) with handle (item 27).
3. Loosen the clamp screw (item 13).
4. Remove the slide assembly with rack (item 3) and gooseneck .
5. Dry and preheat the ladle as recommended by the refractory supplier.
6. After preheating, reassemble the parts in the reverse order.

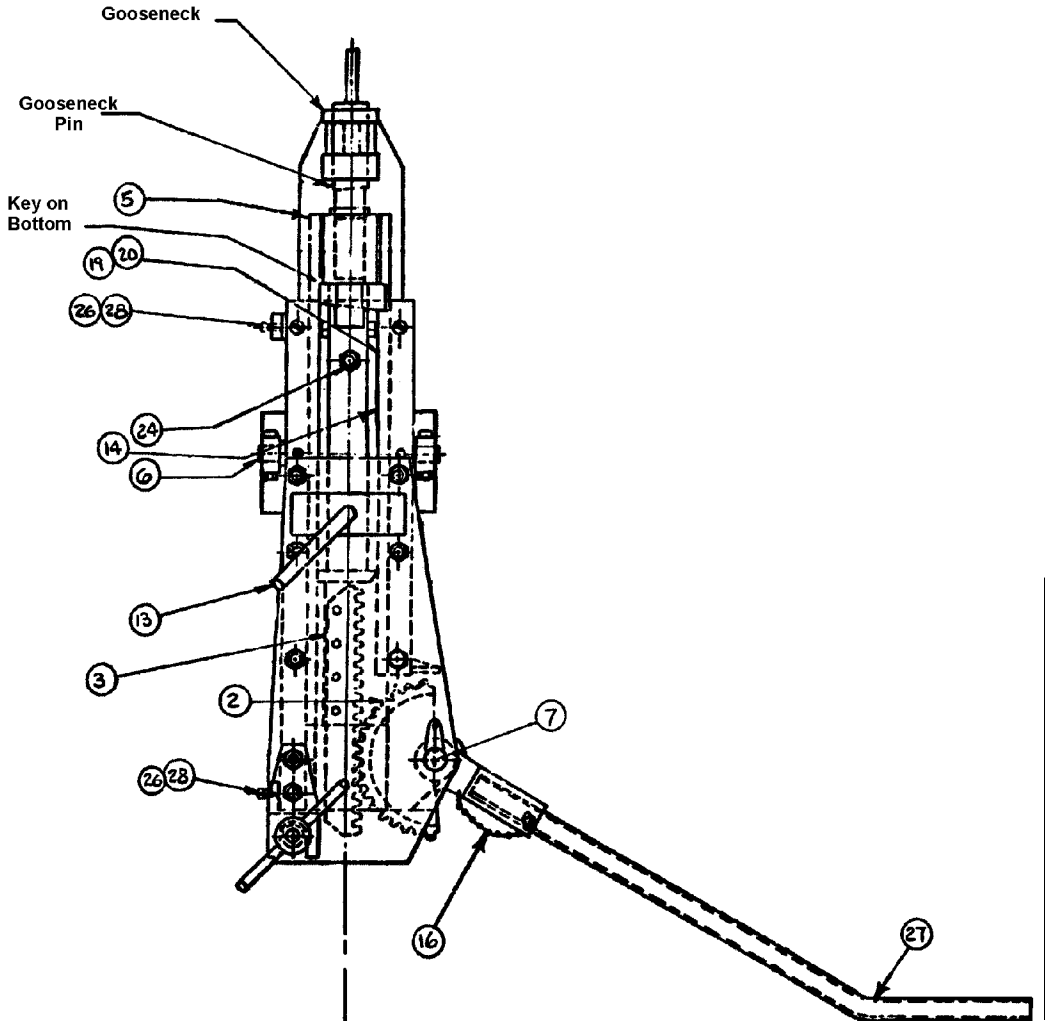
NOTE:	**Refer to Section 3.1, "Pre-Operational Check" for additional information on preheating.**

7. The operating handle (item 27) is to be in the upper position when the stopper head is in the full down position on the nozzle.

4.8.1.2 Lubrication

Prior to use and throughout the service life of the tap rig, it should be properly lubricated with the lubricants called out in Section 4.3, "Lubrication." In high production applications the rack and sector should be independently lubricated. This may be done by brushing or spraying the teeth with an open gear lubricant.

Figure 4-11: Rack Type Tap Rig Components
Typical Reference Drawing U-99947



4.8.1.3 Adjustment

(refer to ***Figure 4-11***)

Hand Lever

The angle of the hand lever may be adjusted for different pouring elevations. This is done before placing the ladle into production by:

1. Swing the sector pin retainer away from the sector pin.
2. Remove sector pin.
3. Disengage the gear sector from the rack.
4. Rotate the gear sector one tooth by pulling the handle up or down.
5. Re-engage the gear sector to the rack.
6. Install the sector pin and sector pin retainer.

If the parts tend to stick, degrease with a non-flammable solvent.

Slide

After years of service it may be required to take up wear between the slide and housing. This is done by adjusting the shims (items 19 & 20) between the clamp bars and the housing slide bearing. Adjustment in the other axis is made by the set screws provided (item 28).

Lock Mechanism

The tap rig is provided with a lock (item 13) to hold it in position when not in use. This lock is to be engaged when the stopper is fully seated and before transporting the ladle with molten metal.

WARNING

NEVER transport a bottom tap ladle without the tapping mechanism locked. Transport with the tapping mechanism unlocked can cause leakage and spillage which can cause severe injury or death to surrounding personnel.

Gooseneck and Tap Rod (refer to ***Figure 4-11***)

The taper pin on the gooseneck engages the slide assembly (item 5), and is held in place by a taper key in the lower keyway. This arrangement allows radial adjustment and will provide stability once the key is firmly engaged. In addition an upper key is provided to reduce the effort required for the removal of the gooseneck.

Prior to use, the gooseneck is aligned with respect to the tap hole, then keyed tightly to prevent radial movement. The tap rod is fixed firmly to the gooseneck by tightening the hex nut assembly. The entire gooseneck and rod assembly can be raised and lowered to align the refractory head with the refractory nozzle. Sand can be sprinkled around the head and nozzle to check for proper alignment. Sand leaks indicate that the head is not aligned.

When the assembly is aligned, the shaft lock screw (item 13) is used to lock the head against the nozzle. The nut on the sleeves my be backed off slightly to allow for temperature expansion.

4.8.1.4 Operation

Before filling the ladle with molten metal, check that the stopper head is seated on the nozzle, and that the assembly is locked down with the lock screw (item 13).

CAUTION

Because of temperature expansion after tapping into the ladle, it may be necessary to unlock and then re-lock the lock screw. This will prevent the tap rod from bending under the expansion forces and will help maintain a proper seat at the nozzle.

WARNING

<u>NEVER</u> transport a bottom tap ladle without the tapping mechanism locked. Transport with the tapping mechanism unlocked can cause leakage and spillage which can cause severe injury or death to surrounding personnel.

Successful operation is dependent on the skill of the operator which comes from experience and observation. The stopper should always be cleanly raised without trying to throttle the flow. To stop the pour, the stopper is to be seated by a firm steady pressure on the handle.

If a nozzle becomes frozen, it can usually be opened with a rod or an oxygen lance. Leaks can occur because of poor alignment, lost stopper heads, or over usage of a lance. To stop leakage, the operator should attempt to throttle the stopper closed rather than place undue pressure on the pouring lever. Trying to force or jam the stopper head usually makes the leakage worse. If leakage still occurs, empty the ladle into the mold to finish the heat, then repair.

DANGER

Safety in the handling of molten metal cannot be over emphasized. Operators should be thoroughly trained to handle normal and abnormal situations. The tap rod should be set with care and operating variables should be reduced in order to avoid abnormal situations. Failure of the operator to be aware of possible abnormal situations can cause leakage or uncontrolled flow from the stopper, causing injury or death to surrounding personnel.

4.8.2 5-Position Bottom Tap Rigs

4.8.2.1 Preheating Instructions

Prior to ladle preheating, the gooseneck is to be removed from the tap rig. Refer to ***Figure 4-12*** and perform the following steps for removal.

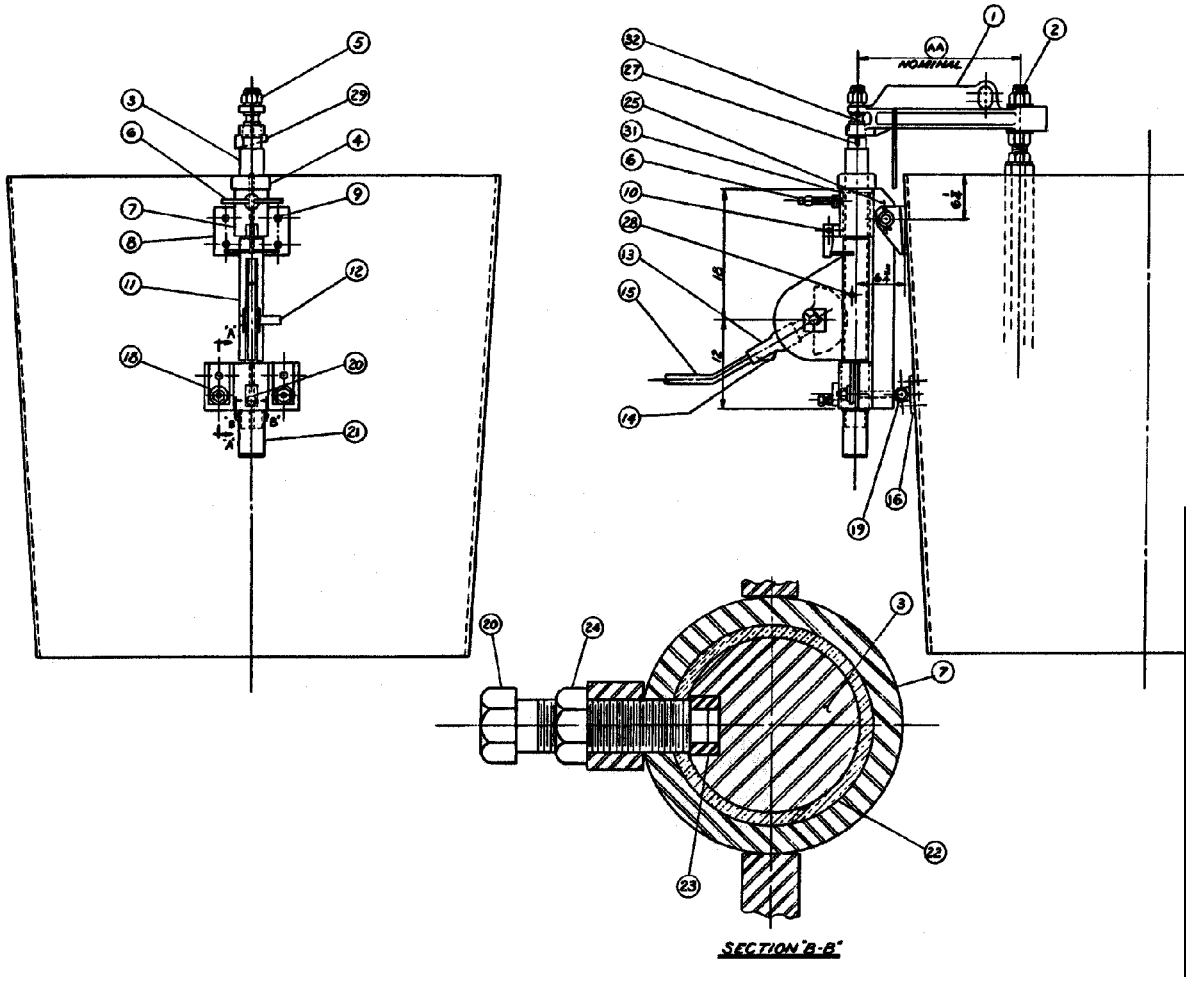
Step:

1. Loosen and disassemble nut (item 5) and lockwasher.
2. Tap the key (item 27) to loosen the gooseneck from the tapered section of the slide shaft (item 3).
3. Remove the gooseneck and tap rod assembly from the slide shaft.

4.8.2.2 Lubrication

Prior to use and throughout the service life of the tap rig, it should be properly lubricated per Section 4.3, “Lubrication.” Self-lubricating bushings (item 22) do not require additional lubrication.

Figure 4-12: 5-Position Tap Rig Components
Typical Reference Drawing U-42791



4.8.2.3 Adjustment

(refer to ***Figure 4-12***)

Hand Lever

The hand lever is able to be operated in five (5) predetermined positions through an angle of 180°. To set the hand lever in one of the five positions, lift the gravity held pawl mechanism (item 10) and rotate the handle to the desired position, then release the pawl into the fixed slot.

Slide Shaft

The key (item 23) on the slide shaft is to be adjusted by the lock nut (item 24) and cap screw (item 20) for radial stability. The slide shaft is to freely move in the slide shaft bushing (item 22).

Lock Mechanism

The tap rig is provided with a lock (item 6) to hold it in position when not in use. This lock is to be engaged when the stopper is fully seated and before transporting the ladle with molten metal.

WARNING

<u>NEVER</u> transport a bottom tap ladle <u>without</u> the tapping mechanism locked. Transport with the tapping mechanism unlocked can cause leakage and spillage which can cause severe injury or death to surrounding personnel.

<u>Gooseneck and Tap Rod</u> (refer to ***Figure 4-12***)

Adjustment and alignment of the gooseneck and tap rod is done by the adjusting nuts (items 17 & 18).

4.8.2.4 Operation

Before filling the ladle with molten metal, check that the stopper head is seated on the nozzle, and that the assembly is locked down with the lock screw (item 6).

CAUTION

Because of temperature expansion after tapping into the ladle, it may be necessary to unlock and then re-lock the lock screw. This will prevent the tap rod from bending under the expansion forces, and will help maintain a proper seat at the nozzle.

WARNING

<u>NEVER</u> transport a bottom tap ladle <u>without</u> the tapping mechanism locked. Transport with the tapping mechanism unlocked can cause leakage and spillage which can cause severe injury or death to surrounding personnel.

Successful operation is dependent on the skill of the operator which comes from experience and observation. The stopper should always be cleanly raised without trying to throttle the flow. To stop the pour, the stopper is to be seated by a firm steady pressure on the handle.

If a nozzle becomes frozen, it can usually be opened with a rod or an oxygen lance. Leakers can occur because of poor alignment, lost stopper heads, or over usage of a lance. To stop leakage, the operator should attempt to throttle the stopper closed rather than place undue pressure on the pouring lever. Trying to force or jam the stopper head usually makes the leakage worse. If leakage still occurs, empty the ladle into the mold to finish the heat, then repair.

DANGER

Safety in the handling of molten metal cannot be over emphasized. Operators should be thoroughly trained to handle normal and abnormal situations. The tap rod should be set with care and operating variables should be reduced in order to avoid abnormal situations. Failure of the operator to be aware of possible abnormal situations can cause leakage or uncontrolled flow from the stopper, causing injury or death to surrounding personnel.

Section 5.0 GENERAL INFORMATION

5.1 Capscrew Torque Chart

When checking capscrew tightness or replacing capscrews, proper torque is to be used. Torque values below are for standard unplated fasteners. If special lubricants of high stress ability, i.e., never-seize compound, graphite and oil, molybdenum di-sulfide, colloidal copper, or white lead are used, multiply the torque value from the chart by a factor of 0.90. If the fastener is cadmium-plated multiply by 0.90. If both nut and bolt are cadmium-plated multiply by 0.80. All torque values below
are in lb.-ft. (pound feet).

NOTE:	**Torque values for capscrews are not effected with the use of Loctite.**

Size (inches)	SAE 2 A307	SAE 5 A449	A325	SAE 8	A490 A354-BD
1/4	6	9	- -	13	- -
5/16	11	18	- -	26	- -
3/8	19	31	- -	46	55
7/16	30	49	- -	74	88
1/2	44	74	103	113	134
9/16	63	104	145	162	192
5/8	86	142	198	225	267
3/4	146	245	337	395	468
7/8	230	386	529	636	755
1	341	574	782	962	1,140
1 1/8	482	814	1,103	1,385	1,641
1 1/4	658	1,113	1,500	1,918	2,273
1 3/8	870	1,476	1,982	2,577	3,052
1 1/2	1,124	1,910	2,556	3,373	3,995
1 3/4	1,768	3,017	- -	5,435	6,434

Section 6.0 MANUAL REGISTRATION

In order for Whiting Corporation to inform ladle users of revisions to this manual, we ask that this page be taken out of the manual, the information filled in, and the page mailed to:

Attention: Customer Service
WHITING CORPORATION
15700 Lathrop Avenue
Harvey, IL 60426
(708) 596-6600

Please provide the following information:

Customer Name:	
Department Name:	
Attention:	
P.O. Box:	
Street Address:	
City/State/Zip:	
Phone Number:	
Fax Number:	
E-Mail Address:	

Fill in the blanks and check all that apply for one type of ladle used. If more than one type is used, please copy and complete a form for each type.

Whiting S/N:	
Requisition / S.O. Number:	
Purchase Date:	
Number Ladles of this Type:	
Ladle Inside Top Diameter:	
Ladle Inside Depth:	
Ladle Type:	❒ Lip Pour ❒ Bottom Tap: ❒ Rack ❒ 5-Position or ❒ Steel Mill ❒ O.T.S. (Outside Teapot Spout) ❒ Geared: Type of Gearing _____ ❒ U-Shape ❒ Treatment
Bail Type:	❒ V-Type ❒ Square ❒ Removable Hook or ❒ Removable Stirrup
Other:	