Instruction Manual *for*

SOUTHERN CROSS

DIRECT ACTING WINDMILLS

"R" PATTERN

Mark RF — 17ft.: Stroke — 7in. Standard
8in. Special

Mark RG — 21ft.: Stroke — 8½in. Standard
10in. Special

Mark RH — 25ft.: Stroke — 9½in. Standard
12in. Special

Manufactured in Australia by TOOWOOMBA FOUNDRY PTY. LTD.
and Marketed by SOUTHERN CROSS MACHINERY COMPANIES.

ERECTING INSTRUCTIONS

FOR

SOUTHERN CROSS

DIRECT ACTING WINDMILLS, "R" PATTERN

On Standard Southern Cross Towers

SOUTHERN CROSS Direct Acting Windmills, "R" Pattern, are soundly engineered and carefully built.

SOUTHERN CROSS Windmills, "R" Pattern, are made to standards and tolerances which are usually set for much more delicate mechanism. Rigid inspections give assurance that there is no deviation in quality.

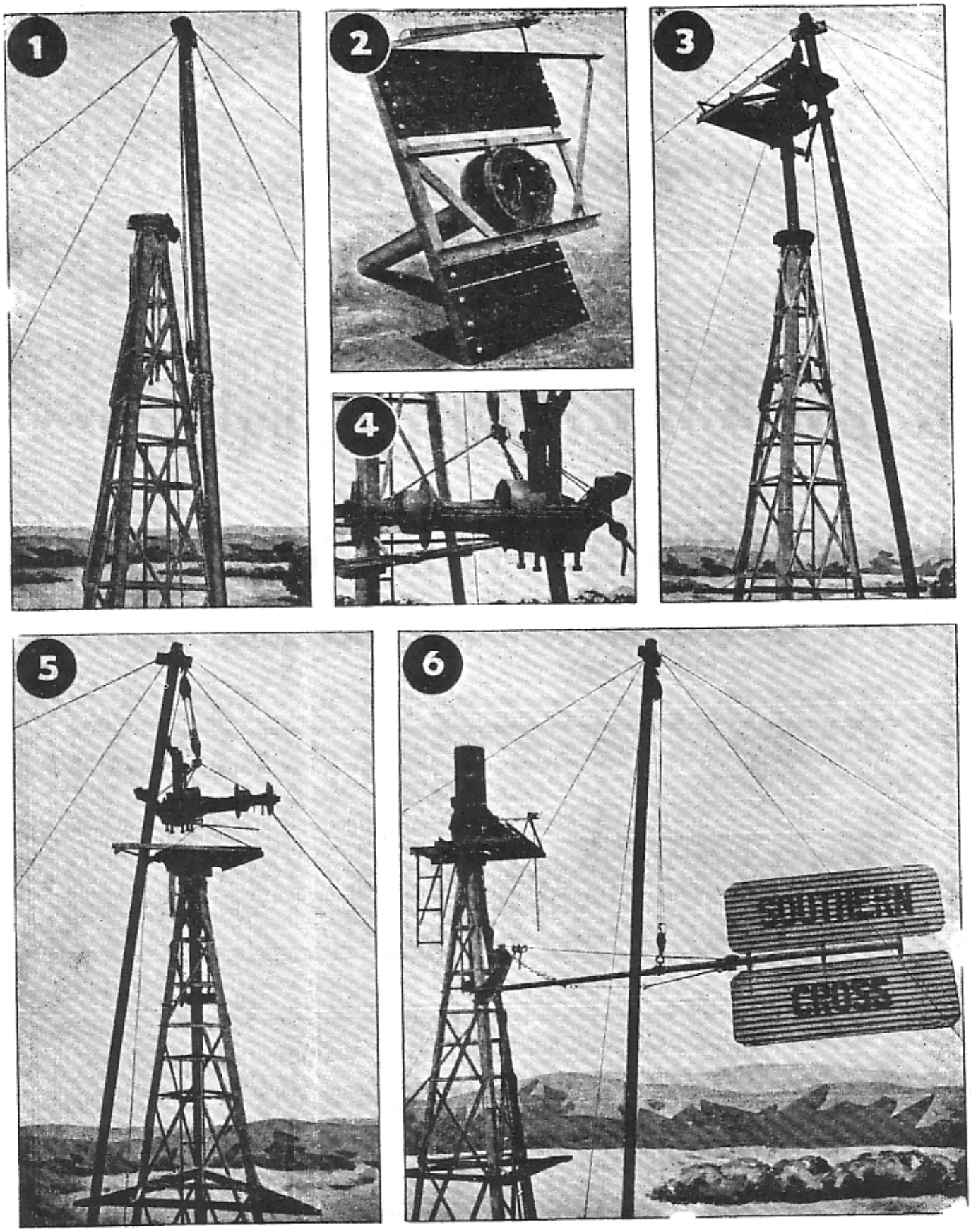
The SOUTHERN CROSS factories are fully equipped with modern machine tools and are operated by efficient methods. Every possible margin of error is held to a minimum.

DOUBLE-ACTING PUMPS INVALIDATE WARRANTY

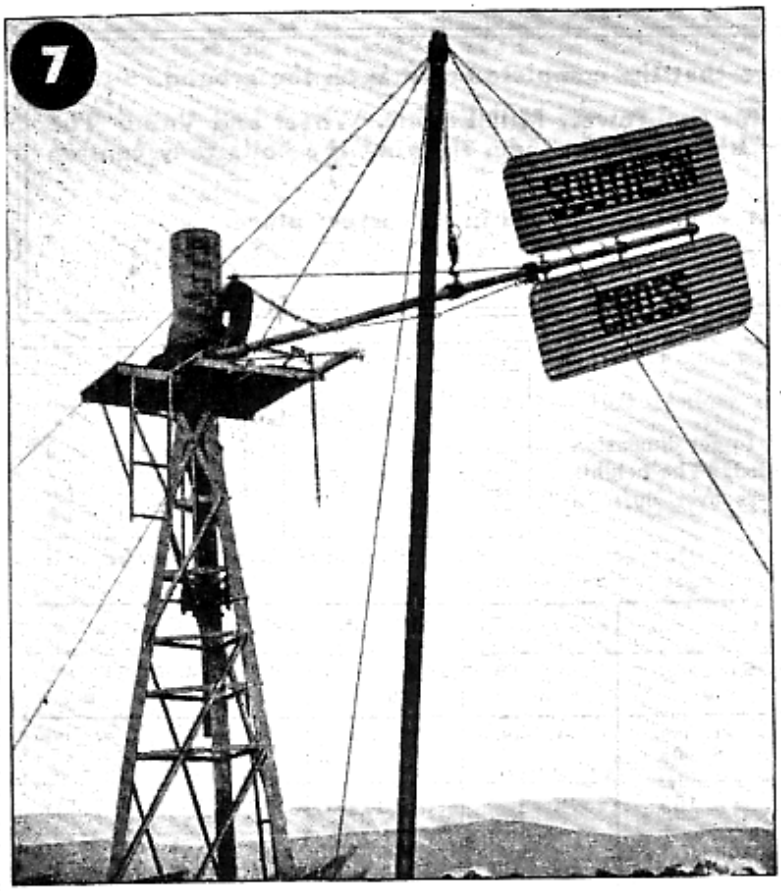
This Windmill is suitable for use with single-acting plunger pumps in which the water is discharged on the "up" stroke. However, it is not suitable for use with double-acting pumps, which discharge water on both the "up" and "down" strokes.

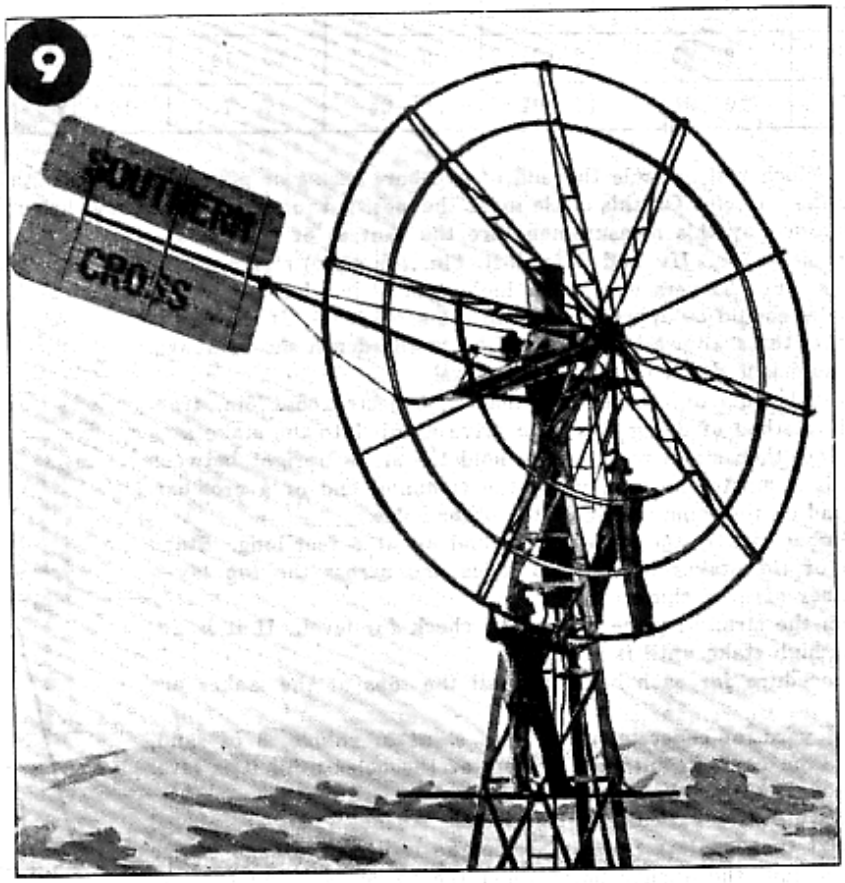
The Warranty on this Windmill will be null and void if it is used with a double-acting pump.

1433/500
3/79 S.C.P.



Stages of Erection (21ft. Windmill shown)





Stages of Erection (21ft. Windmill shown)

Check over all parts to make sure that the complete outfit is on the ground.

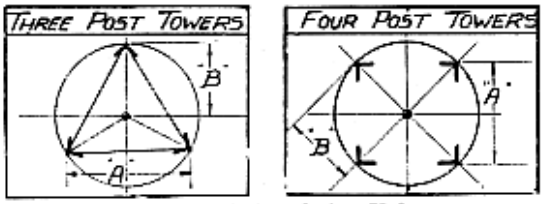
There are separate bags of bolts for the Tower, Mill Engine, Wheel and Vane. The bags for the Mill Engine, Wheel and Vane have a list in them showing the bolts they contain and also where the bolts are used.

When assembling, take care that each bolt is used in its correct place.

The Wheel Arm Bolts are High Tensile Steel.

FOUNDATIONS

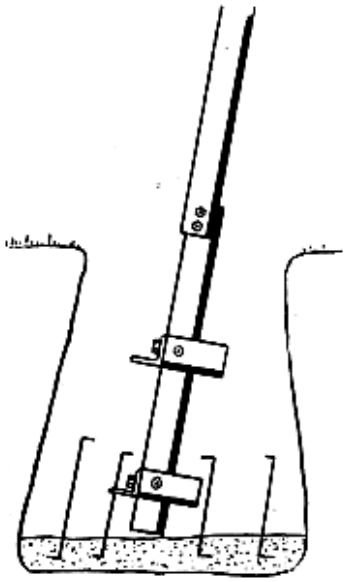
1. Refer to illustration, "Position of Foundation Holes", to get dimension "B" for the size and height of the tower to be erected. The heights shown are measured from ground level. For towers over 60ft., a special sketch will be sent.



Position of Foundation Holes

HEIGHT OF TOWER	17FT. MILL				21FT. AND 25FT. MILLS			
	3 POST		4 POST		3 POST		4 POST	
	A	B	A	B	A	B	A	B
	FT. INS.	FT. INS.	FT. INS.	FT. INS.	FT. INS.	FT. INS.	FT. INS.	FT. INS.
35ft.	10 5⅜	6 0⅜	8 5⅜	6 0⅜				
40ft.	11 11	6 10½	9 7⅜	6 10½	12 1	6 11⅜	9 8⅞	6 11⅜
45ft.	13 2⅜	7 7½	10 8	7 7½	13 4½	7 8⅜	10 9½	7 8⅜
50ft.	14 8	8 5½	11 10	8 5½	14 10	8 6⅜	11 11⅜	8 6⅜
55ft.	15 11⅜	9 2½	12 10½	9 2½	16 1½	9 3⅜	13 0¼	9 3⅜
60ft.	17 5	10 0½	14 0⅜	10 0½	17 7	10 1⅜	14 2⅜	10 1⅜

2. Make a loop of wire which will encircle the end of the bore casing or pump pipe. Fix a stick to the wire at the correct radius, "B" and describe a circle. On this circle mark the position of the foundation holes by marking off dimension "A." The points obtained by this measurement are the centres of the holes.
3. Sink holes (4ft. 10in. deep for 17ft. and 21ft.; 6ft. 6in. for 25ft.) sloping the sides outwards so the bottom of each hole is about 4ft. diameter. For Towers over 60ft. high, special instructions will be supplied for the foundations.
4. **The bottom of the holes should be approximately to the same level. If the site is on a hillside or a slope, the shallowest hole should be to the depth shown above, and the others of a sufficient depth to bring them level.**
5. Drive a stake into the bottom of one hole so that it projects about 6in. from the bottom. A simple method of doing this is to drive a nail into the stake at a point 6in. from the top, then stand in the hole, hold the stake upright between your feet and drive it in up to the nail, using the ramming end of a crowbar. Take another stake and do the same in one of the other holes.
6. Cut two pieces of timber exactly the same length and about 6 feet long. Stand these pieces on top of the stakes in the two holes and across the top lay a straight piece of timber of even thickness.
7. With a spirit level on the straight piece of timber, check for level. If it is not level, drive down the high stake until it is.
8. Repeat the above procedure for each hole until all the tops of the stakes are level.
9. Mix a batch, about ¾ yard, of concrete, using 6 of stone or rubble, 3 of sand, and one of cement. Ram concrete into the bottom of the holes until it is level with the tops of the stakes, i.e., about 6 inches deep.
10. **The reinforcing rods which are packed with the Tower Anchor Posts are placed in the concrete so that they project from it. Keep the rods to the edge of the holes so they will not foul the anchor posts when the tower is being erected. These rods ensure that the concrete, which is put on later, will make a secure joint.**



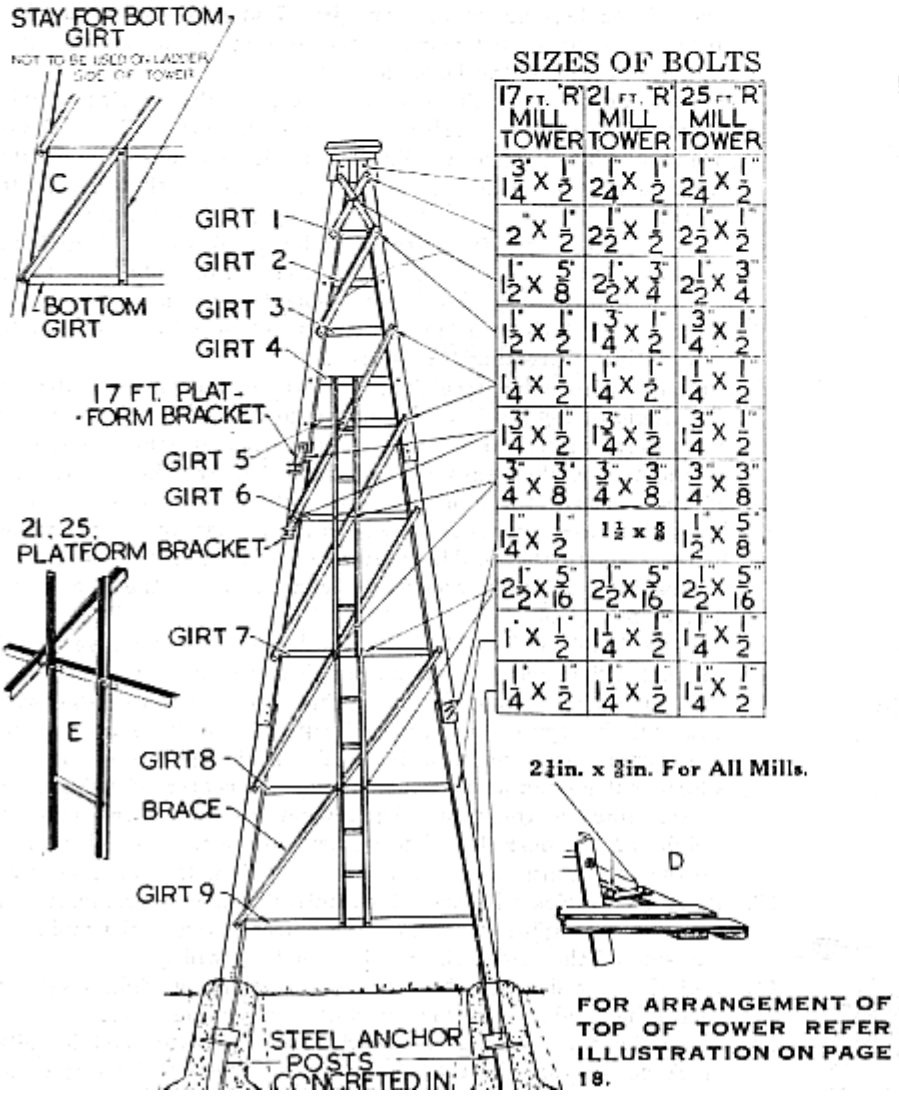
Anchor Post.

11. **The concrete should be allowed to stand for at least 12 hours to let it set.** In the meantime, proceed with the unp ing of the mill engine and assembling it as described on Page 11.

NOTE: **Any spare time during the erection can be used for riveting the fan brackets to the fans, as shown on Page 16, under heading, "Fitting Fans to Wheel".**

ERECTING THE TOWER

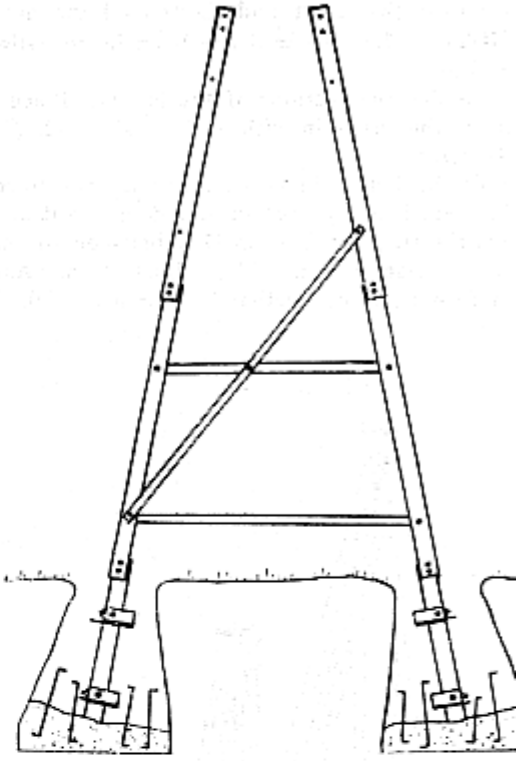
1. Next day proceed with the erection of the tower.
2. Cut the wires on the tower bundles and remove the bag of bolts. Sort out the bolts into their various sizes and, for convenience later, screw the nuts off the bolts.
3. Sort the tower legs. There are three special 10ft. sections for the top to take the tower castings, and these must be set aside. They may be distinguished by the large holes at one end.
4. Pick out the three 5ft. anchor posts. **On 35ft., 45ft., and 55ft. towers, six 5ft. leg sections are supplied. Three are anchor posts and the other three are the bottom sections of legs immediately above the anchor posts.**
5. Bolt the foundation plates to the anchor posts. On 35ft., 45ft., and 55ft. towers, bolt the 5ft. leg sections to the anchor posts. For other towers, bolt a 10ft. leg section to each anchor post. **There is a top and bottom end for all leg sections. The top end is the end with the corner cut away.** Refer to illustration, "Assembled Tower", on this page for bolt sizes. Stand one of these assembled legs in each hole.



SIZES OF BOLTS

17 FT. "R" MILL TOWER	21 FT. "R" MILL TOWER	25 FT. "R" MILL TOWER
1¾" X ½"	2¼" X ½"	2¼" X ½"
2" X ½"	2½" X ½"	2½" X ½"
1½" X ⅝"	2½" X ¾"	2½" X ¾"
1½" X ½"	1¾" X ½"	1¾" X ½"
1¼" X ½"	1¼" X ½"	1¼" X ½"
1¾" X ½"	1¾" X ½"	1¾" X ½"
¾" X ⅜"	¾" X ⅜"	¾" X ⅜"
1¼" X ½"	1½ x ⅝	1½" X ⅝"
2½" X 5/16"	2½" X 5/16"	2½" X 5/16"
1" X ½"	1¼" X ½"	1¼" X ½"
1¼" X ½"	1¼" X ½"	1¼" X ½"

FOR ARRANGEMENT OF TOP OF TOWER REFER ILLUSTRATION ON PAGE 18.



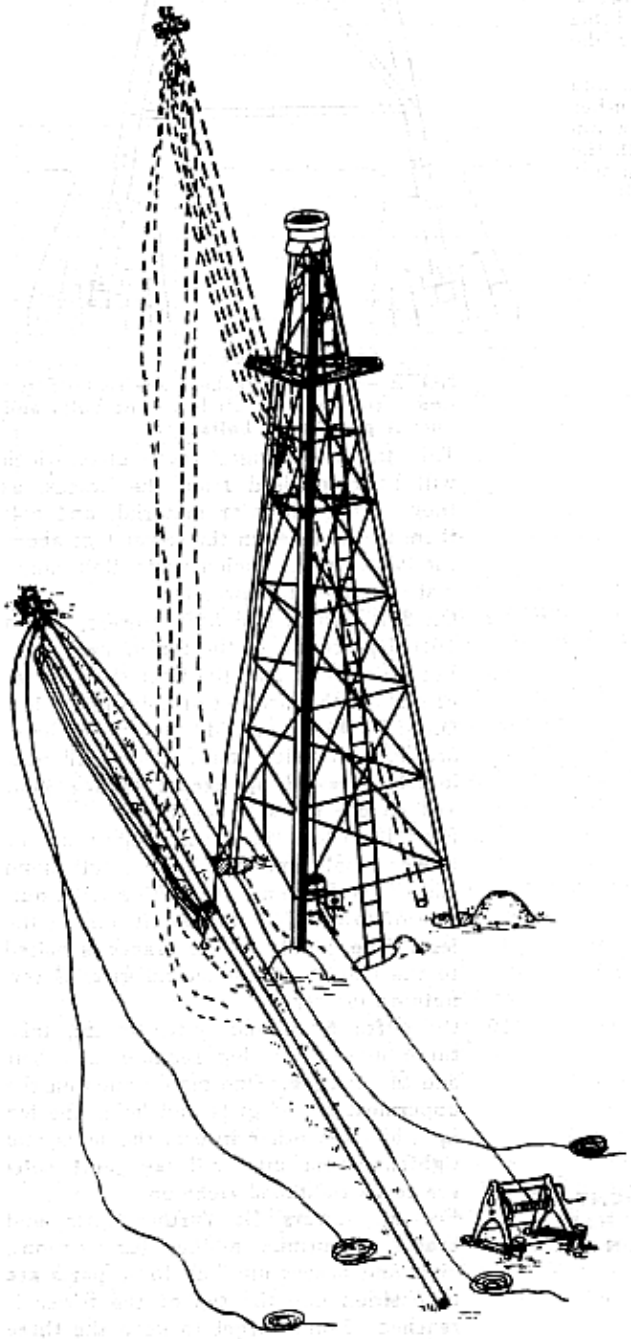
Bottom of Tower.

NOTE:—Spring Washers are to be fi under the nuts on all leg joint bolts anchor post to leg bolts.

6. Take the three longest tower girts, wi will be recognised from the braces, they are of heavier material, and them to the holes in the tower legs at the joints on the anchor posts. Bolt na plate supplied to tower leg.
7. On 35ft., 45ft., and 55ft. towers, bo 10ft. leg section to the top of each l
8. For all towers, bolt the next shortest of girts to the next set of holes in the On 35ft., 45ft. and 55ft. towers the h are above the leg joint. **Leave all loosely screwed up except on leg j and anchor posts to leg bolts.**
9. For all towers, take the longest set braces. Bolt one end to the left h end of the bottom girt, looking from side of tower. **The braces fit outside legs.** The middle of the braces is bo to the middle of the second girt. Sc nuts on loosely.
10. On 40ft., 50ft. and 60ft. towers, t three more 10ft. leg sections and one to each leg. One man stands on uppermost set of girts and holds the up while the other inserts the bolts tightens them up. **All leg joint b are to be tightened right up.**
11. For all towers fit further girts braces. Continue adding leg secti girts and braces until all these parts

On towers for 21ft. and 25ft. "R" Mills, the second girt from the top is fitted outside the legs.

12. Go over the tower and tighten all the nuts.
    NOTE: **After the mill has been in operation 6 months, check all bolts and nuts to see that they are still screwed up tightly.**
13. Assemble the sections of the ladder. Place the side rails on a block of wood with the slotted flange downwards and drive the rungs in with a piece of wood. Then drive the other side rails on. See Section "E" on illustration "Assembled Tower."
14. Bolt the ladder in position outside the tower, using 2½in. x 5/16th Hex. bolts and 1¾in. x ⅜in. pipe distance pieces. If there is a 5ft. section of ladder use it at the bottom. The top of the ladder attaches to the fourth girt from the top.
15. Fit the stay for Bottom Girt between the middle of the bottom two girts. A stay is not fitted on the ladder side of the tower. See section "C" of illustration, "Assembled Tower."
16. Before anything further is done a derrick should be erected.



Erecting the Derrick.

ERECTING THE DERRICK

(Refer to illustration on this page.)

1. The derrick should be of such a length that the top will be 12ft. higher than the top of the tower, and not less than 4in. casing for a 17ft. mill and 5in. casing for 21ft. and 25ft. mills.
2. Screw the casing together and lay it along the side of the tower. The middle of the derrick should be about the middle of the side of the tower.
3. Using a wire rope sling, fix a snatch pulley block to the top of one of the legs above the top girt. Using another rope sling, attach a single pulley block to the bottom of one of the tower legs or the top of the bore casing.
4. Fit a pair of Steel Clamps to the top of the derrick, leaving about 6ins. of the derrick above the clamps. Where clamps aren't available, drive a solid forked piece of bush timber into the end of the casing. Also drive a piece of timber into the bottom of the derrick to stop it digging into the ground.
5. Using a steel sling, fix a treble pulley block to the derrick immediately above the clamps. Also secure four guy lines to the derrick immediately above the treble block sling.
6. Secure the winch to a tree or firmly set posts as shown in the illustration, "Erecting the Derrick."
7. Pull the wire cable free from the winch and reeve it through the single pulley block on the bottom of the tower leg, up outside the tower through the snatch pulley block attached to the top of the tower, then through the treble pulley block at the top of the derrick, through a double pulley block which can be laid anywhere along the derrick, back through the treble pulley block, through the double pulley block, through the treble pulley block and finally secure the end firmly to the eye of the double pulley block.
8. Tie the double pulley block to the derrick with wire so that it will not swing about when the derrick is being raised.
9. Pull on the rope from the pulley block on the top of the tower and pull through a few yards of rope and tie it securely round the derrick at a point a little above the centre of balance, which will be found by trial. Judge the centre of balance for a start and tie the rope. Then wind the winch and take the weight of the derrick. If necessary, lower the derrick and retie the rope until when the derrick is lifted, the top rises first.
10. Raise the derrick with the winch until it comes approximately to its correct position. Then pull the bottom over to the middle of one side of the tower and as close in as it will go.
11. Pull the guy lines to their correct positions at right angles to each other and secure them to posts or suitable trees.
12. Untie the rope around the derrick and take the snatch pulley block down from the top of the tower. Undo the single pulley block from the bottom of the tower leg and attach it to the bottom of the derrick.
13. The derrick is now ready for hoisting the mill engine, etc.

FITTING TOP TOWER CASTING

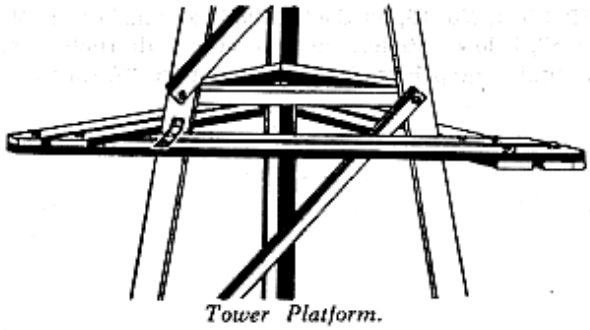
1. Tie a rope sling around the top tower casting and hook it to the double pulley block. Raise it by hand by pulling on the rope till it is above the top of the tower. Lower it into position and bolt it up tightly, using spring washers under the nuts.

ASSEMBLING TOWER PLATFORM

1. Lay out the platform boards on the ground in the same way as it will sit on the tower. See illustration "Tower Platform" below. When looking at the platform from the outside, the boards should be under on the left-hand side, and on top on the right-hand side. Bolt the boards together. There are also three short pieces supplied in the bundle. Bolt one across underneath the middle of each side of the platform.

FITTING THE TOWER PLATFORM

1. Undo the three bolts which will hold the platform brackets to the tower. See illustration, "Assembled Tower" on Page 5.
2. Put the bottom bracket in position on each side and screw nut loosely on bolt. On 21ft. and 25ft. mills the platform brackets fit under the end of the second angle brace.
3. Hang the platform by one corner through the hook on the double pulley block. Raise it by hand by pulling on the fall of the rope till it is higher than the tower. Then lower it, one man guiding it over the tower, so that it will come into its correct position on the bottom brackets, with the short cross boards to the bottom.
4. Put the top brackets in position and mark the holes on the platform. Shift the platform slightly and bore the holes. Then bolt the platform in position.



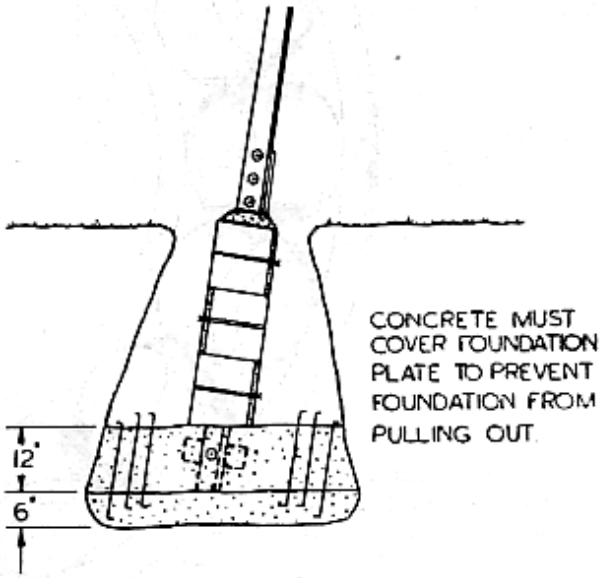
Tower Platform.

PLUMBING THE TOWER

1. Lay a piece of wood on the top tower casting. Attach a plumb line to the piece of wood so that it hangs inside the tower from the centre of the opening in the tower casting. The tower must be adjusted so that the plumb-bob will come over the centre of the bore, and so that each tower leg is exactly the same distance from the plumb-bob.
2. To adjust the position of the tower it is best to put a sling around one tower leg below the top tower casting, and, using the winch, take the weight of the tower on the derrick so that it can be moved readily.
3. First set the legs to the same distance from the centre of the casing. If the plumb-bob is not then hanging centrally over the casing, raise whichever leg is low until it does hang centrally.
4. Then concrete the legs as described below.

CONCRETING THE LEGS

1. **Make sure that the surface of the concrete already put in is clean so that the new concrete will set on to it.**
2. Mix concrete, using 6 of stone or rubble, three of sand and one of cement.
3. Ram about 12 inches of concrete into each hole. Then get some kerosene tins, cut the ends out, and slit them down one corner. Slip them around the posts, bringing the top to ground level. A piece of wire bent around the tins will prevent them from opening out. Fill the tins with concrete, rounding the top so that it will shed water away from the legs. Ram earth around the outside of the tins.



Concreting the Legs.

TOWER CASTINGS

1. Bolt a suspension strap No. 59 to the point where the top flat braces cross on each side of the tower.
2. **Remove the bottom nut and spring washer off each suspension strap and screw the other nut up as far as it will go. Put a turntable stop, No. 36, on each suspension strap and tie it there temporarily with a piece of wire or string. The flanged end of the turntable stop should be to the top.**

3. Place the turntable and pivot near the bore casing in the inside of the tower. Pass a hemp rope down through the top tower casting, tie to the turntable and pull it up. When pulled up, tie the rope round a tower leg. **Do not remove wire binding turntable together.**

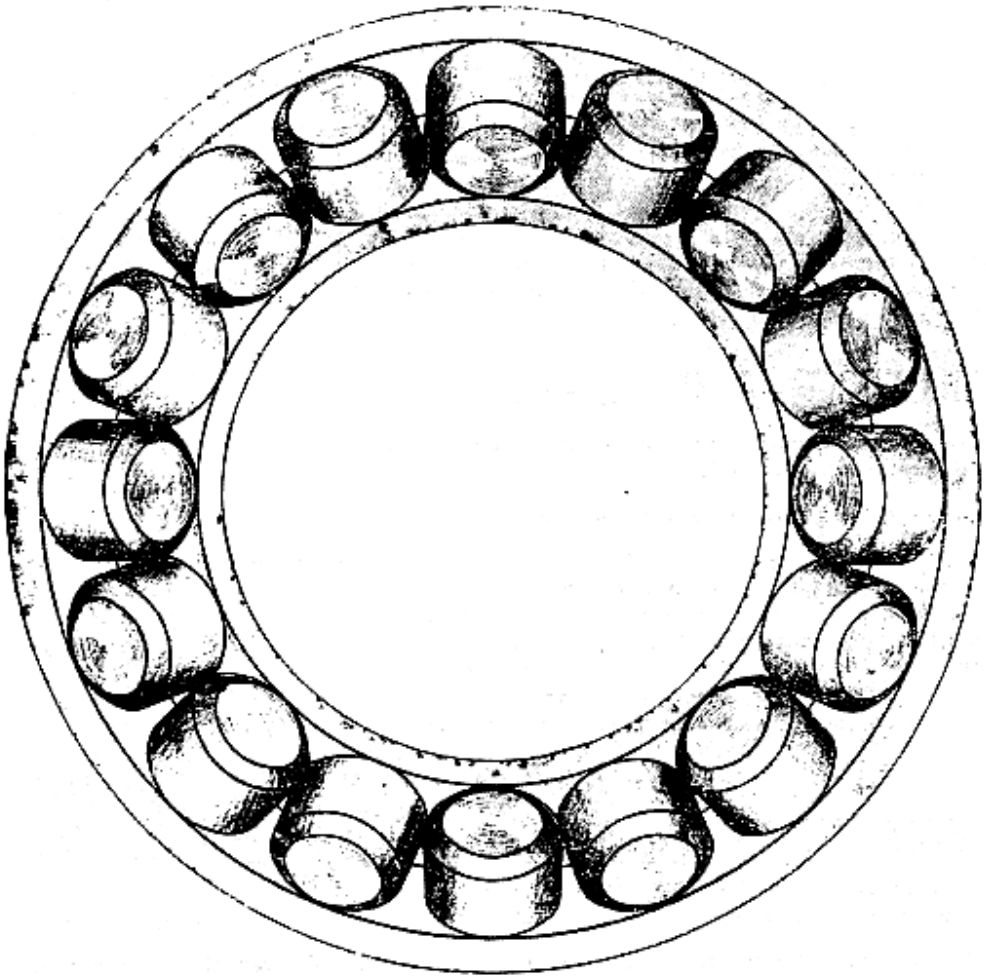
4. Put centering Jacks, No. 117, in the holes in the turntable, No. 15, and a Thrust Block, No. 17, on each Jack. See illustration, "Top Section of Tower", on Page 12.

   When fitting 21ft. and 25ft. "R" Pattern Mills on Four Post Towers, the Centering Jacks, RG115 (for four post towers) may be too long, and it will be necessary to cut them to suit. If so, cut the end not screwed. These centering Jacks are made long because the distances from the turntable to the legs vary for different makes, and it is better to cut the Centering Jacks than have to send for longer ones.

5. Push the turntable up on to the suspension straps, **being careful to see that the boss to take the oil return pipe is immediately below the tapped hole to take 1in. pipe in the top tower casting.** Replace spring washer and nut on each suspension strap and screw on the width of the nut. Cut the wire round the turntable and pivot and also cut the wire or string round the stop pieces.

6. Put Thrust Block Supports on tower legs, underneath the Thrust Blocks.

7. Lift Pivot, No. 19, off the turntable and make sure that the rollers are placed correctly. **See illustration, "Turntable Roller Race", below.** Rollers must be placed alternately, as illustrated. Then replace pivot on Turntable. This is held down by Turntable Stop Pieces. See illustration, "Adjusting Suspension Straps", on page 10.



TURNTABLE ROLLER RACE.

Rotating Platform

Note: All bolts on the rotating platform must be fitted from the top, so the heads are on top and the nuts underneath.

1. With main casting lying on the ground, bolt on the platform angle bearers, Nos. 125 and 126, to the studs in each side of the main casting, using spring washers under the nuts.
2. **Bolt the platform angles, Nos. 121 and 122, to the bearers.** At the same time bolt on the diagonal platform support, No. 143. Then attach platform ladder support, No. 142. See illustration, "The Mill Engine", on page 10. Use spring washers under all the nuts.
3. Bolt the check chain bracket, No. 124, and reefing pulley bracket stay, No. 77, to the platform angles, Nos. 121 and 122. Use spring washers under the nuts.
4. Bolt on the platform boards.
5. Bolt the check chain stay, No. 78, to the check chain bracket, No. 124, and to platform angle, No. 122, and platform angle bearer, No. 126. Use spring washers under the nuts.
   Note: The end of the stay, No. 78, fits underneath the end of the bracket, No. 124, and a pipe distance piece (1¼in. long for 17ft. mills, and 1½in. long for 21ft. and 25ft. mills) is fitted between them. Leave this bolt loose until the check chain is fitted later.
6. Fit the pipe distance piece between the two sides of the reefing pulley bracket, No. 123; bolt it to the stay, No. 77, and tie the loose end of the bracket to the stay temporarily with a piece of wire or string. The pipe distance piece is 1¼in. long for 17ft. mills and 2 1/16th inches for 21ft. and 25ft. mills.

Pulling Up The Main Casting With Rotating Platform Assembled To It.

(1) Make sure that the oil ring is in the top tower casting. Oil it and see that it turns easily.

(2) Attach a wire rope sling through the holes in the main casting and hook in the bottom pulley block. Take the weight with the winch and see that the mast pipe hangs vertically. If it does not, readjust the sling.

(3) Lift it until the end of the mast pipe can be swung across into the opening in the top tower casting.

(4) Smear the top section of the pivot with oil so that the mast pipe will slide on easily.

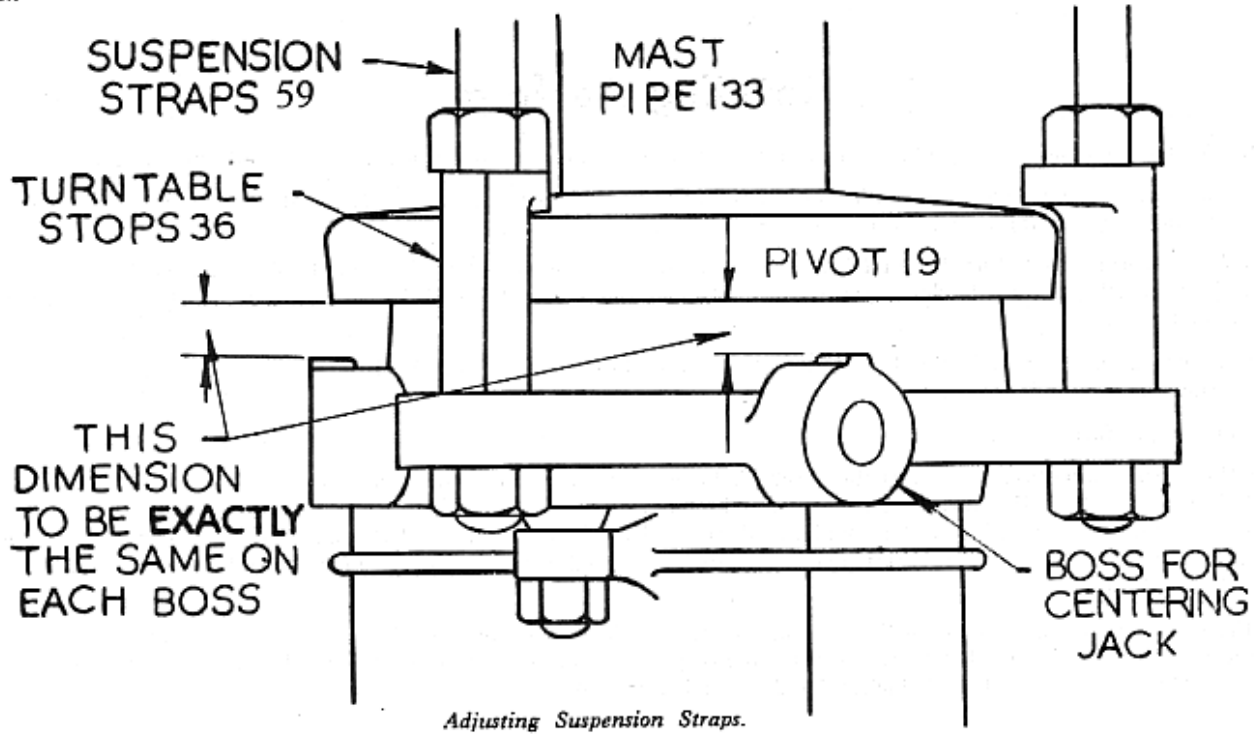
(5) When lowering the main casting, guide the mast pipe on to the pivot so that the drilled hole in the bottom lines up with the tapped hole in the pivot. **Also it is very important to see that the oil ring in the top tower casting, No. 18, is turned until the key on it is immediately below the recess in the top tower casting cover on the main casting.**

(6) Before undoing the sling on the main casting, **try the oil supply pipe which fits between the top tower casting and the crankcase and see that it can be screwed into the oil ring in the top tower casting.** Insert the pipe through the hole in the main casting and top tower casting cover and try to screw the pipe in. IF THE PIPE WILL NOT SCREW IN, IT WILL BE NECESSARY TO LIFT THE MAIN CASTING AGAIN AND CORRECTLY ENGAGE THE KEY IN THE RECESS AS IN (5) ABOVE. THEN TRY THE PIPE AGAIN. THIS PIPE MUST SCREW IN BEFORE ANY FURTHER ASSEMBLING IS DONE. After having made sure that the pipe will screw in, screw it out. It will be put in position after the crankcase is lifted on.

(7) Screw in the setscrew to secure the bottom of the mast pipe to the pivot.

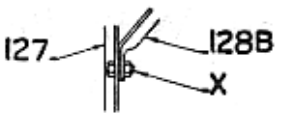
PLUMBING THE MAIN CASTING

1. **Screw up the nuts on the suspension straps by half a turn at a time until the weight of the main casting is taken on the pivot and then continue to tighten the nuts until the main casting is raised about another ¼in. in the tower. This quarter of an inch can be determined by measuring the distance between the lip of the top tower casting cover, No. 23, and the top face of the boss which takes the overflow pipe from the top tower casting to the turntable body.**
2. **Check the measurement between the underneath machined portion of the pivot and the machined surfaces on the turntable, and if necessary slightly adjust the nuts on the suspension straps until the measurement is the same all round. Tighten up the top nuts on the suspension straps to hold the turntable stops down. Then re-check the measurement all round. Also tighten the Thrust Block Supports in position under the Thrust Blocks.**

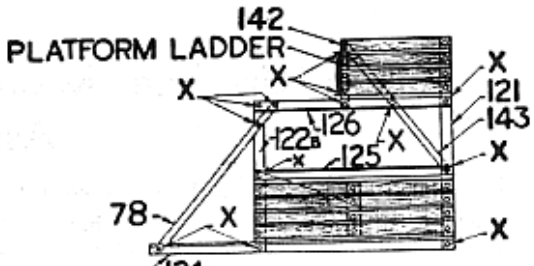


Adjusting Suspension Straps.

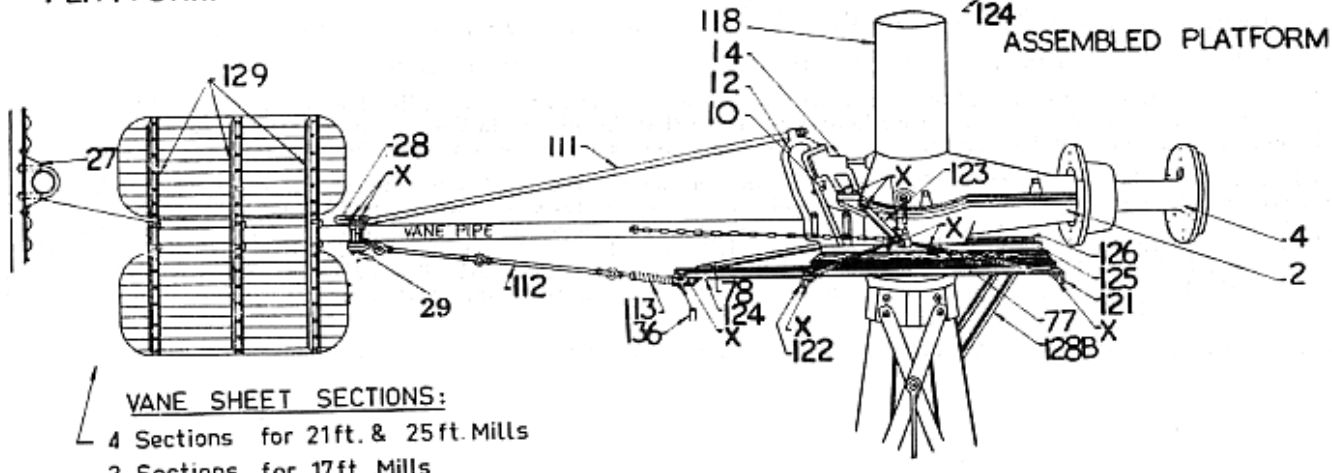
METHOD OF BOLTING LADDER STAY TO PLATFORM



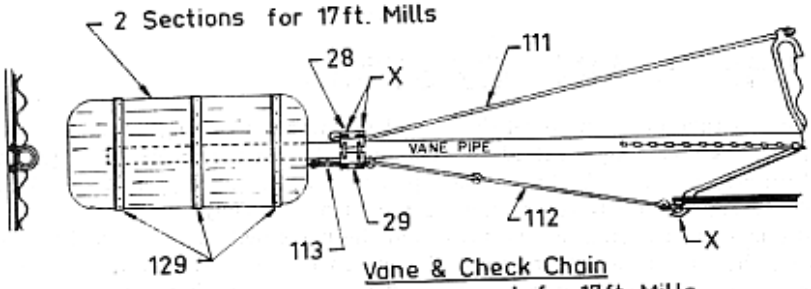
METHOD OF BOLTING LADDER STAY TO LADDER



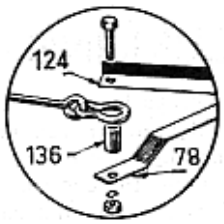
ASSEMBLED PLATFORM



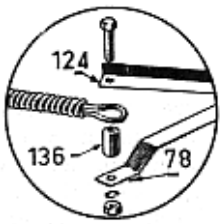
VANE SHEET SECTIONS:
4 Sections for 21ft. & 25ft. Mills
2 Sections for 17ft. Mills



Vane & Check Chain Arrangement for 17ft. Mills.



17 ft. Mills



21ft. & 25ft. Mills

Method of Connecting Check Chain to Bracket.

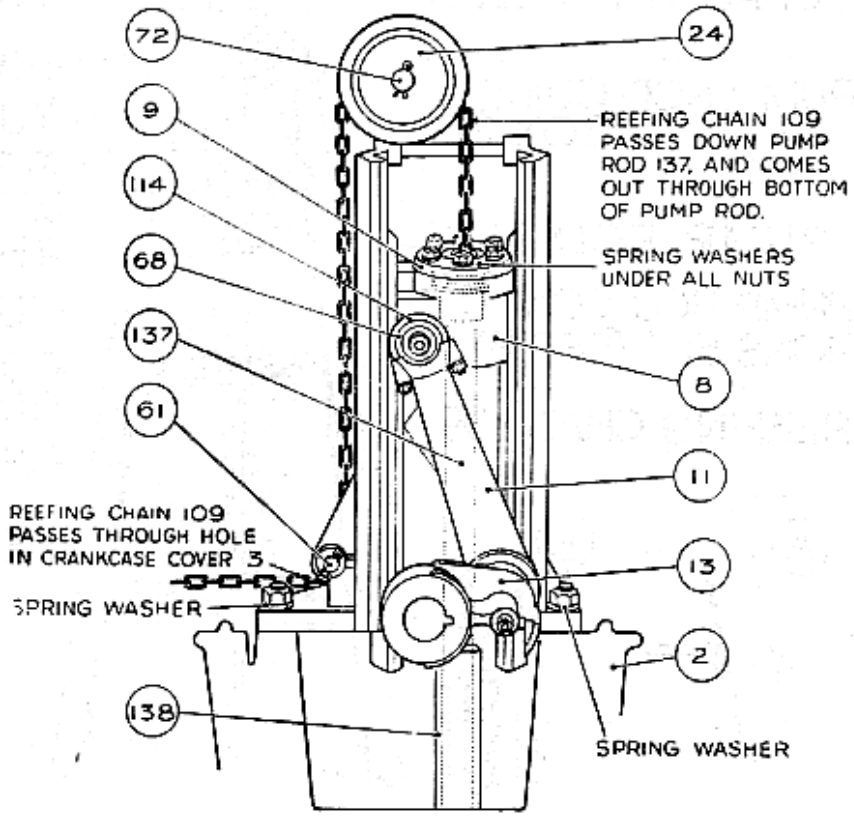
NOTE! BOLTS MARKED "X" TO HAVE SPRING WASHERS.

The Mill Engine.

3. Plumb the Mast Pipe by holding a spirit level against it in different positions around it and adjusting the nuts on the Centering Jacks.
4. **Check over the settings made in 1, 2, and 3 again, to see that they have not altered. These three settings MUST BE CORRECT, otherwise adjust until they are.**
   It is important that the weight of the mill engine and main casting be taken on the Pivot, No. 19, and not on the Top Tower Casting. The correct adjustment in (1) will ensure this.
5. Rotate the main casting by hand to see that it turns freely on the turntable.
6. Bolt on platform ladder, No. 127, and stays, No. 128B, to angles, Nos. 142 and 121 respectively, using spring washers under the nuts.

ASSEMBLING THE MILL ENGINE

1. Remove the Crankcase Cover from the Crankcase.
2. **Clean all grease from Crosshead and Slide Bars,** as grease will interfere with the free flow of lubricating oil from the Crankcase up the Slide Bars and Crosshead, and thus starve the Crosshead Pin of oil.
3. Put the big end of the Connecting Rod on the Crankpin, replace the Washer and Crankpin Bolt, and put the Cotter Pin back.
4. Bolt the Slide Bars and Crosshead in position on the studs in the Crankcase, fitting spring washers under the nuts. **The clearance between the Crosshead and Slide Bars has been correctly adjusted in the Factory and must not be altered.**
5. Put the Connecting Rod Small End Bush in position on the Crosshead and bolt it to the Connecting Rod with the "U" bolt. **There is only one correct position for the Connecting Rod Small End Bush. The "Pip" in the seat for the bush in the Connecting Rod MUST fit into the groove in the Small End Bush.**
   NOTE: After the mill has been in operation for six months, check all bolts and nuts to see that they are still screwed up tightly. Especially check the Con. Rod Small End Bolt.

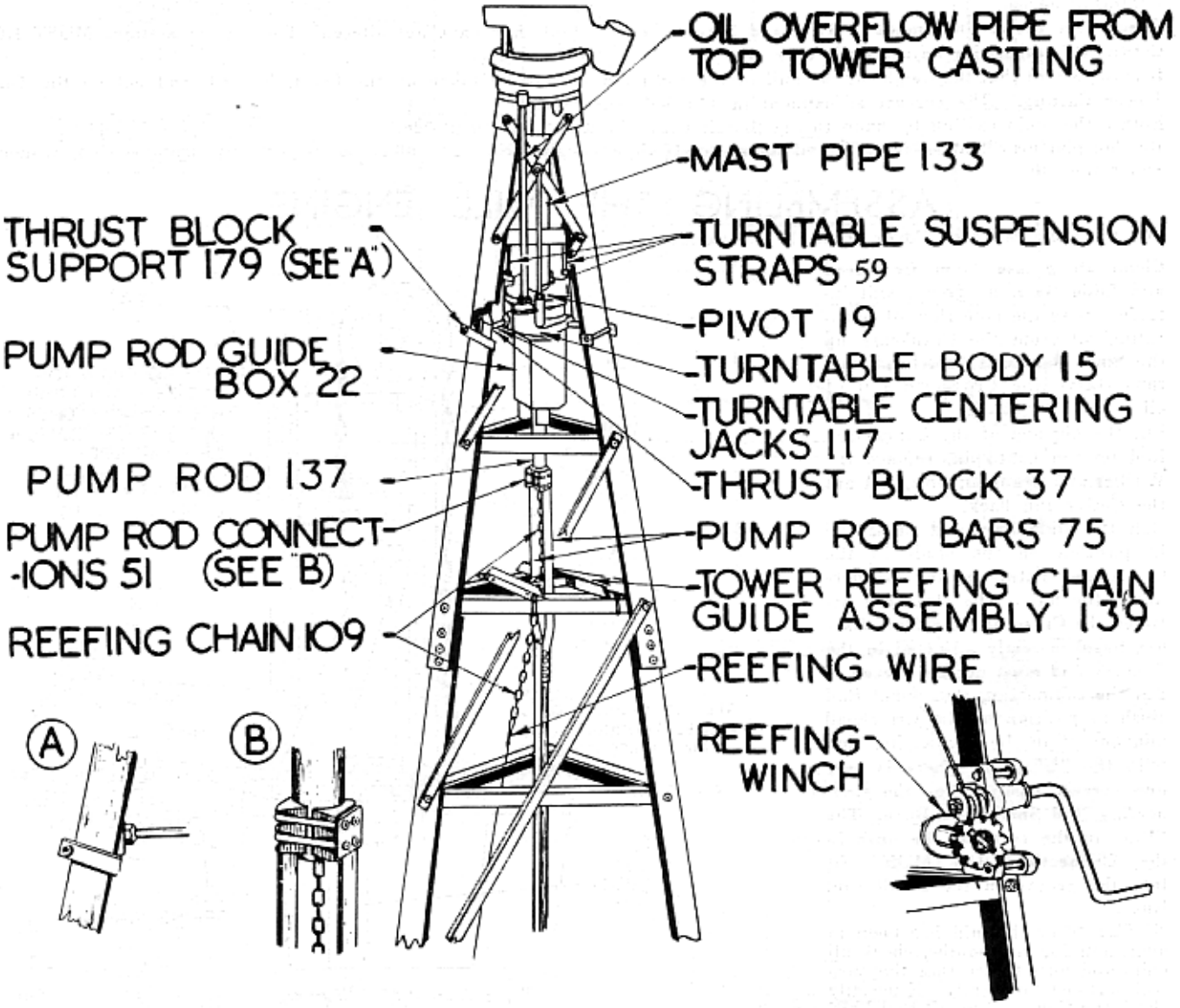


Top Section of Mill Engine.

6. Bolt the Oil Splash Guard in position on the Crankcase.
7. Bolt the Vane Hinge Bearing, No. 14, in place on the Crankcase, using spring washers under the nuts.

PULLING UP THE MILL ENGINE

1. Attach a wire rope sling around the Wheel Hub and Vane Hinge Bearing.
2. Hook in the bottom pulley block and take the weight, using the winch. If the mill engine will not hang in a horizontal position readjust the sling until it will. If the mill engine tends to tip one way it may be necessary to use an additional sling around the bottom of one of the slide bars to hold it steady.
3. Pull up the mill engine and swing it over the main casting. Remove the nuts from the studs under the crankcase.
4. Guide the mill engine down slowly being careful to see that the studs underneath enter the main casting correctly. If the studs foul the edges of the holes the threads will be damaged. **Also see that the Vane Hinge Bearing on the Crankcase is directly above the Vane Hinge Bearing on the Main Casting.**
5. Bolt the Crankcase to the Main Casting, using spring washers under the nuts.
6. **Screw in the oil supply pipe between the top tower casting and the crankcase. Insert the pipe in the hole in the boss in the crankcase and screw it firmly into the tapped hole in the oil ring.** If this pipe is not screwed in, oil cannot be pumped up to the mill from the ground. Then screw the elbow and oil spout on to the pipe.
7. Pull up the crankcase cover and lower it into position, making sure that the felt seal is in place on the Crankcase. Bolt it down tightly. On 25ft. mills, make sure the felt seal is in place between the two halves of the cover.
8. On 17ft., 21ft. and 25ft. mills, insert the Vane Hinge Bearing Oil Pipe through the hole in the Crankcase Cover, fit the Gasket and the Collar, and screw the pipe into the Vane Hinge Bearing. **When the Pipe is screwed in, the cut-away section of the pipe must be to the top to catch oil drips from the Crosshead.** Shift the Collar and Gasket up against the Crankcase Cover and lock in position with the setscrew.
9. For all mills carry the pump rod, No. 137, up the tower, remove the swivel flange, No. 9, oil the swivel and insert the pumprod down through the hole in the Crosshead, No. 8, and then replace the swivel flange. See illustration, "Top Section of Tower", on page 12.



Top Section of the Tower (3 Post).

Spring Washers are Used on the Following Bolts and Studs:

VANE HINGE BEARING (14) TO CRANKCASE (2).
PUMP ROD GUIDE BOX (22) TO TURNTABLE (15).
SWIVEL FLANGE (9) TO SLIDE BARS (16).
CRANKCASE (2) TO MAIN CASTING (1).
PUMP ROD U-BOLT (100) TO PUMP ROD (137).
PLATFORM LADDER (127) TO ROTATING PLATFORM ANGLE (Vane Side) (122).
PLATFORM LADDER (127) TO LADDER STAYS (128).
FRONT AND BACK BARS OF WHEEL ARMS (84 and 85) TO WHEEL HUB (4).
PLATFORM ANGLES (121, 122, 125 and 126) TOGETHER
CHECK CHAIN BRACKET (124) TO PLATFORM ANGLES (121 and 122).
REEFING PULLEY BRACKET STAY (77) TO PLATFORM ANGLES (121 and 122).
CHECK CHAIN BRACKET STAY (78) TO PLATFORM ANGLE (122).
REEFING PULLEY BRACKET STAY (77) TO REEFING PULLEY BRACKET (123).
REEFING PULLEY BRACKET (123) TO CRANKCASE (2).
CHECK CHAIN BRACKET STAY (78) TO CHECK CHAIN BRACKET (124).
VANE STAY AND CHECK CHAIN CLIPS (28 and 29) TOGETHER.
PUMP ROD GUIDE (21) TO PUMP ROD "U" BOLT.

REEFING CHAIN

1. Put the top reefing pulley spindle No. 72 in position in the top of the slide bars, fit the top reefing pulley, No. 24, and put the cotter pins in place.
2. Untie the loose end of the reefing pulley bracket, No. 123 and bolt it to the crankcase.

3. The reefing chain, No. 109, is made with two lengths of chain joined together with the reefing swivel, No. 161. The end which has the eye bolt fitted to it is the top end. **Oil the swivel.**
4. Take the bottom end (end not fitted with the eye bolt) of the chain, thread it through the reefing pulley bracket, through the hole in the crankcase cover, round the small reefing pulley at the bottom of the slide bars, over the top reefing pulley and lower it carefully down inside the pump rod.
   The top end is allowed to hang loose until the vane is in position and it can be connected.
5. The Sheet Iron Cover can now be put in position. For 25ft. Mills the sheet iron cover is supplied curved and edged ready for assembling, and it will be necessary for the erector to join up the sides and double edge the top.

VANE

1. The vane pipe, No. 134, has four holes drilled in it. One set of holes is close together and on the same side. The Check chain clip, No. 29, and vane stay clip, No. 28, are attached to the pipe with the pips of the vane stay clip casting locating in these holes. At the same time attach the check chain, No. 112, and vane stay, No. 111. The vane stay is on top.
   The other two holes (which is really one hole drilled right through the pipe), are at right angles to the check chain clip and vane stay clip bolts, and are for the eye bolt on the end of the reefing chain.
2. The vane pipe is attached to the vane hinge, No. 12, with the hole for the reefing chain nearest to the hinge. Screw up nuts on the vane stay, No. 111, until the tension is well taken. Tie the end of the check chain to the Vane Hinge for convenience later.
3. Build the vane on the ground. Refer to illustration, "The Mill Engine", page 10. On 17ft. mills, vane sheets overlap.
4. Bolt the vane sheets to the vane ribs. On 17ft. and 21ft. mills, the distance from the end of the vane sheet to the nearest vane rib is different at each end. Fit the vane sheets so the shorter end is nearest the mill engine.
5. Attach the vane to the vane pipe, keeping it as near to the end as possible. Use vane clip castings, No. 27, for 21ft. and 25ft. Mills.
6. Put a sling around the vane at the point of balance, and lean the derrick, by altering the guy lines, so that the vane will be lifted to the correct position on the mill.
7. Lift the vane up to its approximate position. **Then turn the mill engine at right angles to the vane so that the vane is on the left when looking from the wheel hub.**
8. Lift the vane high enough so that the vane hinge can be pushed down and with the vane hanging at an angle, the vane hinge will slide into its bearings.
9. Undo the sling.
10. Bolt on the vane hinge stop, No. 10.
11. Attach the other end of the check chain between bars Nos. 78 and 124, using pipe distance piece, No. 136.
12. Bolt the eye bolt on the end of the reefing chain to the drilled hole in the Vane Pipe.
13. **Grease the exposed links of the reefing chain and run the chain backwards and forwards several times to see that it is working properly. This enables the vane to swing back freely when the mill is unreefed.**

OIL PIPES AND PUMP ROD GUIDE BOX

1. Bolt the Pump Rod Guide, No. 21, to the Pump Rod, No. 137, using plain and spring washers under the nuts on the U-Bolt. The plain washer is fitted next to the pump rod guide casting. **When the pumprod guide is bolted on, refer to illustration, "Pump Rod Guide Box and Turntable", on Page 14, and check the measurement referred to in the NOTE.**
2. Lift the pumprod guide box with the guide rods, No. 62, inside, up over the pumprod, making sure that the guide slides over both ends of the rods. Then slip the guide box into position, and before bolting it into place, fit the felt strips between the top of the guide box and the turntable.
3. Attach pumprod connections and pumprod bars to the bottom of the pumprod by means of the U-Bolts and clamps provided. See that the U-bolts are pulled up tightly, and that the connections fit snugly around the pumprod. **Spring washers are used under the nuts.**
4. **3-Post Tower:** Fit the tower reefing chain guide assembly, No. 139, with the shorter angle placed so that it is between the pumprod bars and the legs to which the reefing winch is to be attached. See illustration, "Top Section of Tower", on page 12. Attach the assembly to the girts by means of four hook bolts and set it so that the reefing chain just fits into the pulley when the chain hangs down free.

   4-Post Tower: Fit the tower reefing chain guide assembly, No. 194, so that the reefing chain just fits into the pulley when the chain hangs down free, and the pulley is on the same side of the chain as the leg on which the reefing winch will be mounted. Attach the assembly to the girts by means of four hook bolts.
5. Screw the cover, No. 50, on to the long thread of the 1in. oil overflow pipe from the top tower casting, No. 17, as far as it will go, and put that end of the pipe into the hole in the turntable, No. 15. The bolts in the bottom end of the top flat braces need to be loosened to do this. When the pipe is screwed into the top tower casting as far as it will go, screw the cover, No. 50, down firmly on to the turntable body.

6. Screw the 3/8in. to ½in. reducing nipple into the hole in the top tower casting and screw on the ½in. elbow.

7. Screw the 1in. to ¾in. reducing bush into the bottom of the pump rod guide box.

8. Fit a brass connection to one end of both the Oil Supply Pipe and the Oil Return Pipe. Remove the packing wire from each connection, but leave the ferrule in position on the fitting. Soften ends of polythene pipes using a blow lamp. **Take care not to play the direct flame onto the pipe.** Hold the flame 2 to 3 inches from the pipe and move the lamp steadily around the pipe to ensure uniform heating of the end. As soon as the end of the pipe can be flattened by pressing lightly with the fingers, slip it onto the connection, up to the shoulder. When the pipe is cold, screw the ferrule back, over the pipe.

9. Take the oil supply pipe (½in. pipe) up the tower and allow it to hang freely inside the tower while screwing the connection into the elbow at the top tower casting. Similarly, connect the oil return pipe (¾in. pipe) to the reducing bush in the bottom of the pump rod guide box.

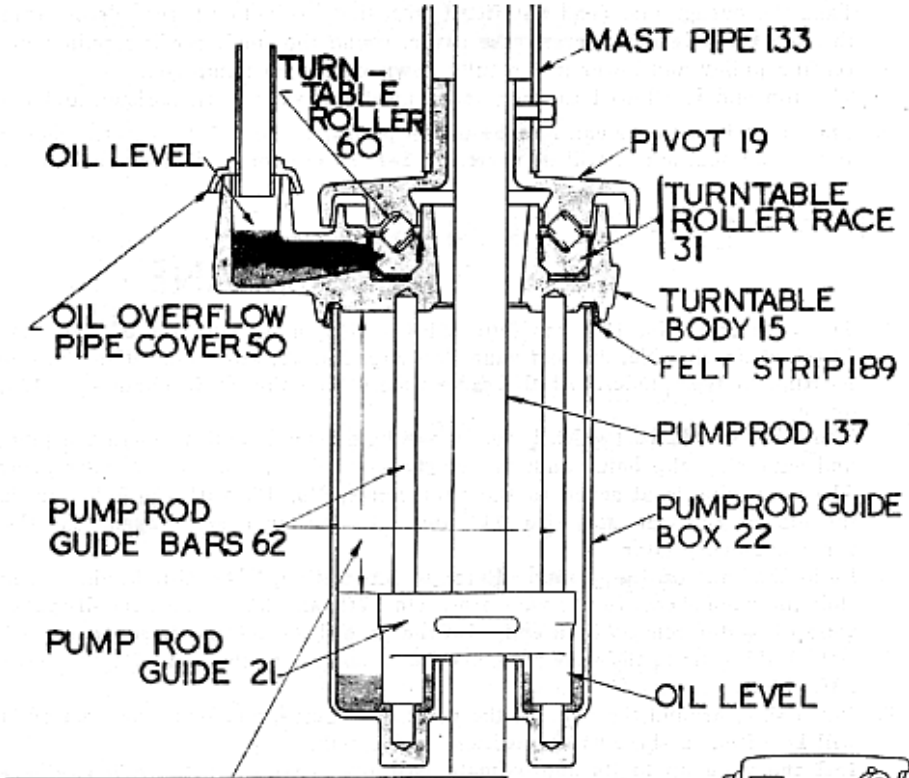
10. Attach the oil pipe brackets as shown in the illustration, "Oil Pipe Bracket", so the oil pipes are held into the nearest corner of the tower. One bracket fits on the third set of girts from the ground and one on every second set above that. When clamping the pipes to the brackets, **allow some slack in each short bracketed length of pipe to allow for expansion and contraction in summer and winter.** To determine the amount of slack to allow, first take up all slack and then slacken off 1½ inches for every 10ft. length. After allowing slack in the first short length, fit the clamp and tighten and then repeat the procedure for the short length between the next two brackets, and so on.

IMPORTANT: If the pipes are not left slack, as shown on this page, they are likely to pull off the end connections.

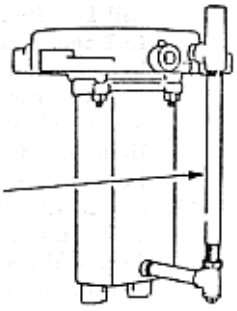
11. Fix the oil pump to the bottom girts of the tower. Take the 2ft. 6in. length of oil return pipe, fit the oil pump lever fulcrum, No. 163, over it, and screw the pipe into the return pipe hole on the oil pump. Screw a ¾in. socket on to the top of the oil return pipe and screw in the ¾in. connection. Fix the oil pump lever in position.

12. Screw the 3/8in. to ½in. reducing nipple into the oil pump, screw on the ½in. socket, and then screw in a ½in. connection.

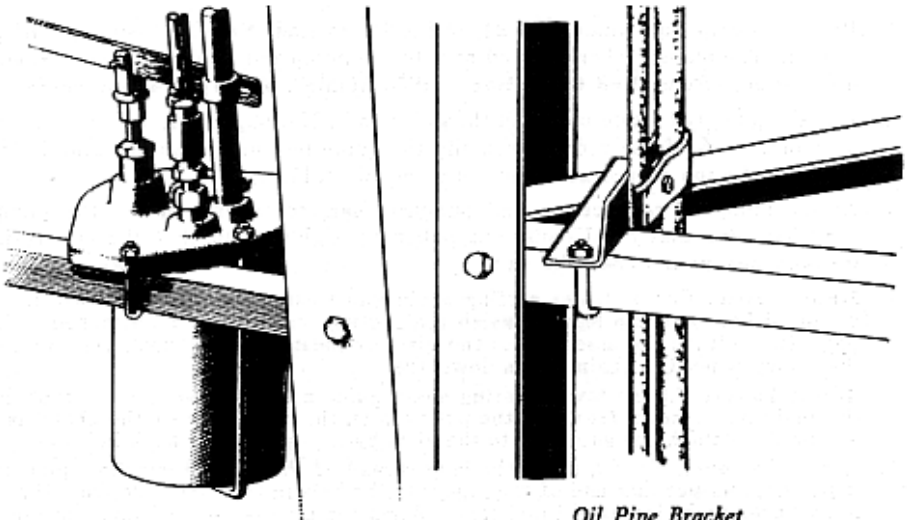
13. Cut both polythene pipes to length, allowing slack in each pipe as in (10) above. Soften the ends of the pipes and fit them on the connections as in (8) above.



Pumprod Guide Box and Turntable



Arrangement of Oil Overflow Pipe from Turntable to Guide Box—21ft., 25ft. Mills



FITTING OIL PUMP

Oil Pipe Bracket

REEFING WINCH AND PULLOUT WIRE

1. Attach the winch to the tower leg nearest the shorter angle of the Tower Reefing Chain Guide Assembly, No. 139. See illustration, "Top Section of the Tower", on page 12.
2. Fasten one end of the pullout wire to the lower end of the reefing chain by means of the rope thimble and rope clips supplied.
3. With the vane in the unreefed position (i.e., in line with the mill engine), unwind the rope off the winch and attach it to the pullout wire by means of the rope clips.
4. Reef the mill.

WHEEL ARMS AND RINGS

1. Pull the wheel arms and rings up with the rope on the derrick, or for 17ft. and 21ft. mills, sling a single pulley block from the angle on the edge of the Rotating Platform, and pull them up, using a hemp rope which is passed through the block.
2. Pull up an arm and bolt it to the bottom of the wheel hub, on the back of the flanges. **When correctly fitted, the back of the arm is perpendicular and the front tapers to the outer edge of the wheel.** To bolt the arm on after it is pulled up, one person stands on the tower platform and holds it while another person bolts it in position. Leave the bolts loosely screwed up. **Make certain that the special High Tensile Steel Bolts which are packed separately in a bag labelled, "Wheel Arm to Wheel Hub Bolts", are the bolts you use, and also make certain that you fit spring washers under the nuts.**

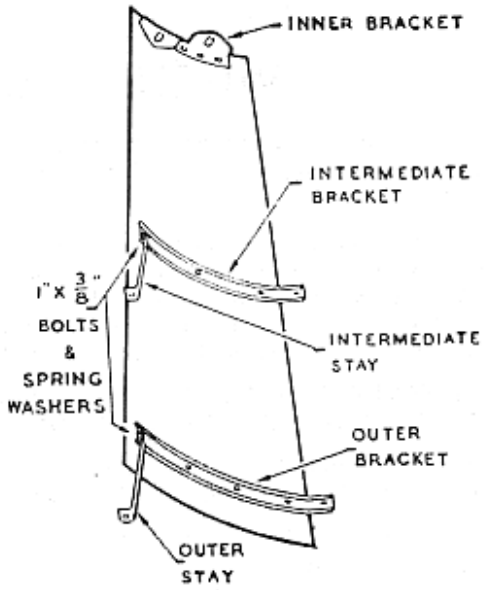
   THE HEADS OF THE WHEEL ARM BOLTS FIT AGAINST THE CAST IRON FLANGES, AND SPRING WASHERS MUST BE FITTED BETWEEN THE NUTS AND THE WHEEL ARMS.
3. Turn the wheel hub around half a turn by hand so that the wheel arm fitted, is now directly on top. Pull up another arm and bolt it on the bottom of the wheel hub, leaving the bolts loose.
4. Turn the wheel hub until the two wheel arms fitted are almost horizontal, and fit another arm on the bottom of the wheel, leaving the bolts loose.
5. Turn the wheel hub another half turn, and fit another arm, leaving the bolts loose. Follow this procedure of balancing the wheel until all the arms are fitted.
6. Pull up all the outer rings and lie them through the corner of the tower on the third top girt.
7. All the outer, intermediate, and inner ring sections are fitted so the horizontal flange of the angle is nearest the mill. **Fit spring washers to all bolts and leave all bolts loose until wheel is fully assembled.**
8. Fit the outer ring first, lapping the ends the same at each joint. **Bolts are to be put through all holes at the lap joints.** Unless this is done, difficulty may be experienced later in fitting the fans at the lap joints. **Leave all bolts loose.**
9. Fit the intermediate ring in a similar manner.
10. The lap on the inner ring sections is different to that on the other rings. Bolt the left-hand end to one wheel arm and allow the right-hand end to extend one bolt hole past the next arm. Lap the sections the same at each joint and insert one bolt to hold the ring to each arm. The other lap bolt is fitted when the fans are put on.

LOWERING THE DERRICK

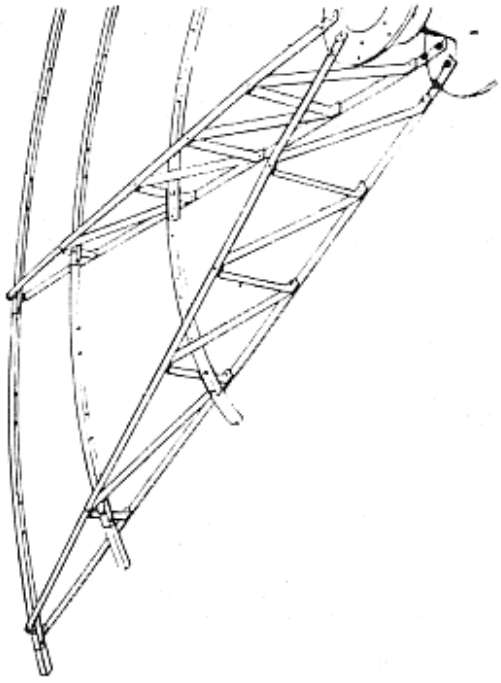
1. There is no further use for the derrick so it can be lowered.
2. If treble and double pulley blocks are used for pulling up the mill engine, etc., take the rope out of one side of each, so that they are, in effect, only double and single pulley blocks.
3. A rope should be tied between the bottom of the derrick and the bottom of the leg, which will be nearest the derrick when it is lowered. This rope will stop the bottom of the derrick from fouling the tower as it is lowered.
4. Put a wire rope sling around the top of one of the tower legs and hook the single block to it.
5. Slacken off the guy lines, release the pawl on the winch and lower the derrick. Use the brake on the winch to prevent it going too fast and guide it with the guy lines.

FITTING FANS TO WHEEL

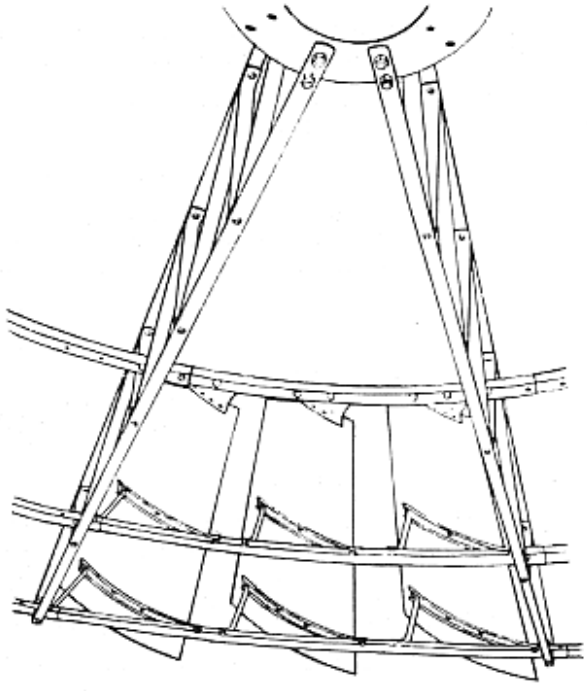
1. While the fans are on the ground, rivet the brackets to them as shown on illustration, "Riveting Brackets to Fans". Put each rivet through the brackets, then through the fan and fit a washer before burring over.
2. Bolt fan bracket stays to the fans, the longer stay being fitted to the outer bracket. Fit the bolt so the head is against the fan and fit a spring washer under the nut.
3. Attach a single pulley block to the vane pipe and pass a hemp rope through it.
4. Pull up the fans one at a time and bolt them on, leaving the bolts loose. By bolting a fan on one side of the wheel and then fitting the next fan on the opposite side, the wheel can be kept balanced.
5. After all the fans have been fitted to the wheel, the wheel bolts should be tightened in the following order:—
   (a) Tighten wheel ring to wheel arm bolts on **outer** ring.
   (b) Tighten remainder of bolts on **outer** ring, making sure that the outer stay does not twist towards the centre of the wheel.
   (c) Tighten wheel ring to wheel arm bolts on **inner** ring.
   (d) Tighten remainder of bolts on **inner** ring.
   (e) Tighten wheel ring to wheel arm bolts on **intermediate** ring.
   (f) Tighten remainder of bolts on **intermediate** ring, making sure that the intermediate stay does not twist towards the centre of the wheel.
   (g) Tighten wheel arm to wheel hub bolts.



Riveting Brackets to Fans



Fitting Rings to Wheel
(Viewed from behind Wheel)



Fitting Fans to Wheel
(Viewed from behind Wheel)

OILING THE MILL

INITIAL OILING:

1. Using the rope sling and pulley block on the vane pipe, pull up the required amount of oil to the mill engine. The mill will require:—
   (1) 17ft., 4 gallons ——— (2) 21ft., 6 gallons ——— (3) 25ft., 8 gallons.
   The recommended oil for use with this Windmill is Southern Cross Windmill Oil for "JA" and "R" Pattern Windmills.
2. Make sure the tap on the bottom of the oil container is "off" and then pour oil into the crankcase until it overflows down the hole through which the oil supply pipe, No. 132, protrudes.
3. Fill the top vane hinge bearing spout with oil. Oil the connecting rod small end, slide bars, and swivel.
4. Turn the wheel over a few times by hand and it will be noticed that the crank will displace a certain amount of oil which will flow down to the oil container.
5. Fill the oil container to about three-quarters full and then work the oil pump until oil begins to flow back to the oil container. This may take some time, as the oil supply pipe up to the mill engine will have to be filled by the pump before any oil flows into the mill engine.
6. When the oil flows back to the oil container, turn the mill over again a few times by hand to displace excess oil in the crankcase. When the overflow to the oil container has ceased, open the tap and drain the oil from the container.
7. Remove the inspection plate from the pump rod guide box to see that the guide dips into the oil.
8. Oil the reefing pulleys on the platform bracket and tower reefing chain guide assembly.
9. The mill is now fully oiled.

EVERY 12 MONTHS:

1. Open the tap on the bottom of the oil container and drain it. Water may collect in it due to condensation.
2. Check that the inside of the container is clean and then pour in clean oil until about three-quarters full.
3. Work the oil pump until oil begins to flow back to the oil container. After the windwheel has made several revolutions and the overflow has drained back into the container, drain the oil from the container.
4. Oil the reefing pulleys on the platform bracket and tower chain guide assembly.
5. Grease pumprod where it goes through the wooden pumprod guides.

EVERY 5 YEARS:

1. Drain the oil out of the crankcase and clean it out to remove any accumulated sludge.
2. Refill with "Southern Cross" Windmill Oil and follow the same procedure as for the "Initial Oiling".

CONNECTING UP TO PUMP

A wooden pumprod connects between the pumprod of the mill and the pumprods of the well or bore. Lift the pumprod in the bore 1in. and then, with the mill at the bottom of the stroke, cut the wooden rod to the correct length and connect up. Grease the pumprod where it goes through the wooden pumprod guides.

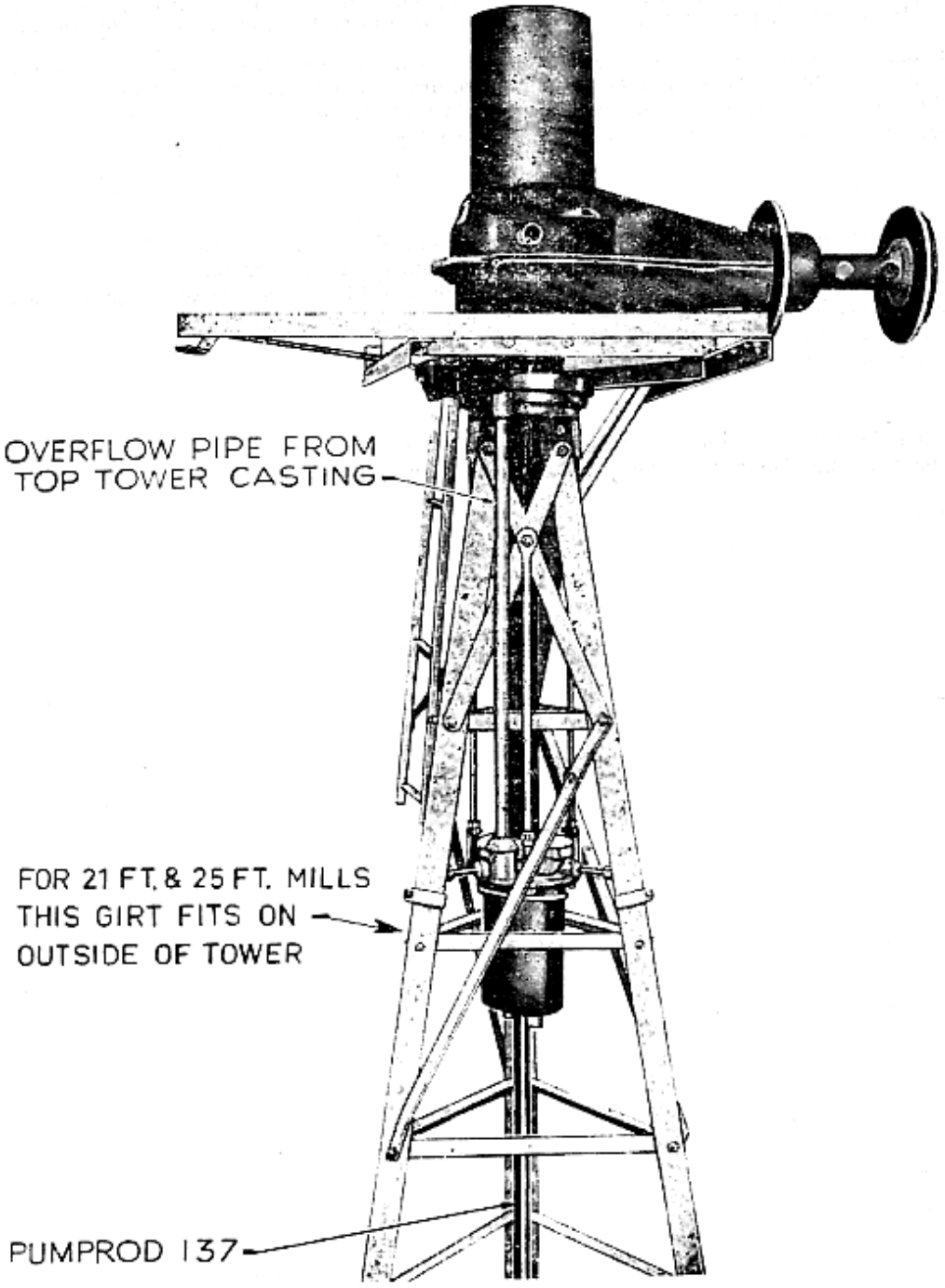
DRAW PLUNGER PUMPS—

Each Southern Cross Draw Plunger Pump has an instruction tag attached. Read the Instructions carefully before installing the pump and connecting bore pumprods to the Mill.

"LR" Pattern Draw Plunger Pumps are distinguished by the cylindrical stainless steel valves. When connecting bore rods and mill rod, using this pump, or Draw Plunger Pumps made **prior to 1958**, the bore rods have to be lifted 7 inches.

On Southern Cross Draw Plunger Pumps made **after 1958, but prior to the introduction of** "LR" Pattern Draw Plunger Pumps, the bore rod has to be lifted only 1 inch.

If in doubt about a pump, screw the pump plunger down onto the bottom valve assembly, and raise both assemblies to the top of the pump. Look into the bottom of the pump barrel, and if the pump has a recessed section in the bore, the pumprod has to be raised 7 inches when connecting up. If it is not recessed, the pump rod has only to be raised 1 inch.



Arrangement of Top of Tower for 17ft., 21ft. and 25ft. Mills

4-POST TOWERS—

On oil overflow pipe side o tower fit:—

17ft. Mill:

(a) Heads of Top Tower Castin bolts to outside of tower.

(b) Flat Braces inside tower leg

(c) First Girt outside tower legs.

21ft. and 25ft. Mills:

(a) Top Braces inside tower leg

(b) Bent Girt, with bent sectio towards inside of tower, t clear oil pipes.

BALANCING OF SOUTHERN CROSS DIRECT ACTING WINDMILL WHEELS—"R" PATTERN

We supply Balance Weights with all Southern Cross Direct Acting Windmills to balance the Weight of the Pumprods.

If Balance Weights are not used, then the Mill, besides having to lift the water, will have to lift the Pumprods on each upstroke.

The extra load of pump rods can be counter balanced by attaching balance weights to the rear side of the wheel arm but no further out along the wheel arm than the intermediate ring . Determine the number to use by trial, placing them opposite the Crank, **but with not more than one balance weight on an arm, as shown in the illustration, "Balancing the Wheel". Remember, on no account must the balance weights be placed on the wheel arm past the intermediate ring.**

When properly balanced the Wheel should stop in almost any position, tending rather to become stationary when the Crank is well past half-way on its upstroke rather than in any other position of the Crank.

To balance, first see that the pump piping is full of water, so that the loss of weight due to the rods being in water is allowed for, and then attach the Balance Weights as stated above.

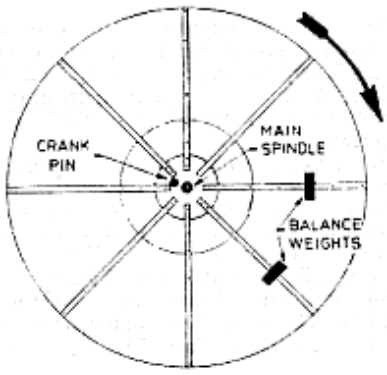
It is found an advantage generally to attach a Leading Weight as shown, to assist in carrying the Mill over the end of the stroke.

A Mill connected to a Syphon Pump will probably need only one Balance Weight.

DO NOT OVERBALANCE THE MILL.

To give some idea of the weight of rods to be balanced, a 21ft. "R" Mill working on a 400ft. lift, using ¾in. Pipe Rods, with Mark KE-E Screwed Pumprod Joints, would have an effective weight of rods to lift equal to about 500lb.

This extra load on the Mill will seriously overload it, and make it sluggish to start in light winds. But if Balance Weights are attached they counter balance the 500lb. weight, and the Mill has only to pump water.



BALANCING THE WHEEL

NEVER tie the wheel to the tower, as this will prevent the Mill from turning on its turntable should the wind change, and could result in serious damage if the wind change was violent.

Pump Troubles.

This section has been written with a view to assisting in diagnosing and remedying pump troubles. It should be read right through carefully before commencing to attend to a Pump. Everyone should be careful when a Pump is not working, or working indifferently, to observe it while the Mill or Engine is working, before commencing to pull it up. This observation of the symptoms will most usually enable the trouble to be seen immediately.

The most usual signs of trouble encountered with Well or Bore Pumps are:—

(1) Pump not delivering any water.

(2) Pump delivering a steady supply but less than previously.

(3) Pump delivering a full supply when started, but output gradually diminishing as pumping is continued, occasionally accompanied by:—

(4) Pump making slight knocking noise and water splashing out over the Spill Piece.

(5) Or loud knocking noise on down stroke, causing whole Mill to resound accompanied by diminished supply, or none at all.

(6) Water receding in pipes when Pump is stopped, and needing some strokes before water reaches the top when it is started again.

(7) Spasmodic action, Pump delivering full supply at times and abruptly ceasing, and perhaps starting again just as abruptly.

No. 1 may be caused by:—

(a) Broken Pump Rods or Joints.
(b) Worn-out Leathers.
(c) Plunger Valve holding up.
(d) Bottom Valve holding up.
(e) End of suction above water, or hole in Suction Pipe above water level.
(f) Leakage in Discharge Pipe between Pump and T-Piece.
(g) Suction Pipe completely blocked.
(h) Suction Pipe too long; that is, Pump too far above water level.

(a) If the Rods are broken and there is no other defect, the Pipes will stay full of water to the T-Piece. Usually it can be decided that Rods are broken by turning the Windmill by hand. The absence of any appreciable resistance to the turning will indicate broken Rods.

(b) Worn Leathers do not usually cause a complete cessation but rather a steadily diminishing supply. Knowledge of the length of time the Leathers have been in use is a guide to their condition. It is advisable to study the other symptoms and if they can be eliminated it may be decided that worn Leathers are the cause of the trouble; that is to say, that if the diminution has been continuous over a period and there is no knocking or splashing of water over the Spill Piece and the Pipes stay full when the Pump is stopped, worn Leathers are certainly the cause.

(c) When the Plunger Valve is held up by some obstruction, the water in the Discharge Pipe will stand at the level of the T-Piece with practically no movement when the Pump is working. A few sharp blows on the rods while it is working may cause the Valve to seat correctly and commence pumping. This, however, is not a permanent remedy and it is advisable to get the Pump up and fix the Valve at the first opportunity.

(d) If the bottom Valve is held up the water in the pipe will rise and fall with the Rods. The remedy is to get the Pump up and remove the obstruction.

(e) A hole in the Suction Pipe above water level or the suction being completely above the water will cause the Pump to deliver air instead of water.

(f) A leakage in the discharge is not usually so large as to cause complete stoppage in delivery but rather a reduction. A split pipe will be indicated by diminished output from the Pump and when the Pump is stopped the water in the Pipes will recede. (See Case 2c.)

(g) If the Suction Pipe is choked no water at all can enter the Pump.

(h) No Pump should be more than 20 feet vertically above water level; less if possible. If a Pump has a long Suction Pipe and the water level recedes to 25ft., or 30ft. below the Pump, the delivery will cease completely or partially and symptoms will be as in Case 5 on Page 21.

Case No. 2 may be caused by:—

(a) Worn Leathers.
(b) Worn Valves.
(c) Leakage in Discharge Pipe.
(d) Diminished supply in bore.

(a) If, when the Pump is stopped, the water stands at the top of the Pipe, the cause of a diminished supply is most usually worn Leathers, or a worn Plunger Valve, or both. Pull the Pump out and renew the Leathers and examine the Valves. See cases (b) and (c).

(b) If the Leathers are good and the Valves only are leaking, then the water will recede when the Pump is stopped.

(c) A leakage in the Delivery Pipe will probably take the form of a split pipe, and in this case the water will recede when the Pump is stopped. A split pipe is sometimes difficult to locate. All pipes should be examined carefully as they are pulled up. It is advisable to replace a split pipe with a new one, but if a new one is not available, the split may be repaired by cleaning the pipe thoroughly with a file, if necessary, over the whole length of the split and binding stout galvanised wire tightly round the pipe, continuing beyond the end of the split and then soldering this wire to the pipe over the split.

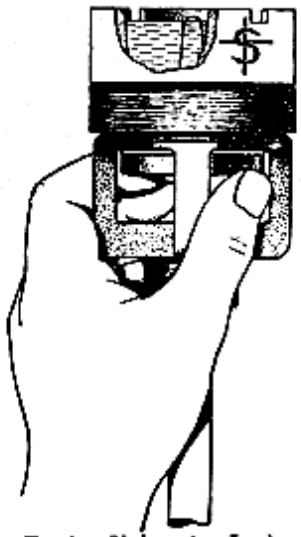
Cases Nos. 3 and 4 will be caused by a failing supply in bore or well. After Pump has been stopped for some time it has a body of water to start on which has accumulated while it has not been working. When this accumulation has been exhausted and the supply coming into the bore or well is not sufficient to fill the Pump at each stroke, then part air and part water is pumped, and it is the bubble of air rushing up the pipe under pressure which causes the splashing of water over the Spill Piece. The failure of the supply can be definitely proved by pouring a plentiful supply of water into the bore or well while the Pump is working and immediate alteration will be seen in the amount of the discharge.

Case No. 5 will be caused by either too long a Suction Pipe, too small a Suction Pipe, or the Suction Pipe being partially choked. What happens is that the water does not flow into the Pump Barrel behind the Plunger when it is on the up stroke sufficiently fast to fill the space left vacant by it, which tends to cause a partial vacuum below the Plunger. On the commencement of the down stroke of the Plunger the whole of the water above the Plunger falls with it through the partial vacuum until the Plunger meets the water imprisoned in the bottom of the Barrel. Water is practically incompressible and the resounding knock which occurs is water hammer, set up by the sudden arresting of the long column of water which is above the Plunger. This water hammer is very often mistaken for a knock in the Windmill itself. Certainly it can sound as if it is. The knock will not do as much damage as might be expected, but will probably cause split Pipes or split Pump barrel ultimately. To avoid any possibility of this happening a sound rule is to have not more than 18 feet of Suction Pipe below the Pump and see that it is at least half the diameter of the Pump, and see that the Strainer and Check Valve, if any, give a waterway the full size of the pipe.

Case No. 6 will be caused either by leaking Valves or leaking Delivery Pipes. See No. 2 (b) and (c).

Case No. 7: This is not unusual in old Pumps. It is caused by scale and rust from the inside of the Pipes falling down and holding up the Plunger Valve. See No. 1 (c), on Page 20.

Care of Pumps.



Testing Valves for Leaks

The following notes will be of assistance to those not familiar with pump repairs:

(1) When renewing Buckets several points need care:—

(a) Soak the Leather Buckets in water to allow them to swell before fitting, and when fitted to the Plunger see that it works freely in the Cylinder.
(b) When cutting out the centre of the Buckets be careful that the hole is concentric with the outside of the Bucket. To do this place the Cage inside the Bucket so that it is even all round and mark the circle of the inside of the Cage with a pencil.
(c) When assembling or dissembling the Pump do not use pipe tongs on the Cylinder—one on each of the hexagon ends will do.
(d) To unscrew the plunger, place the cage in a vice so two of the webs sit against one jaw and two against the other jaw. Allow the cage to sit loosely between the jaws and **do not use any pressure** or the cage may be damaged. If a vice is not available, hold the cage by inserting a bar through it. The plunger follower may be unscrewed by holding a short piece of bar against the lugs provided, and tapping it with a hammer.
(e) When reassembling screw everything up tight.

(2) Leaking Valves are not difficult to locate; test the bottom one by filling the Barrel and watching underneath the Valve for leakage. The Plunger Valve can be tested by inverting the Plunger and holding the Valve against its seat with the fingers. (See illustration.)

Fill the inside of the Plunger with water and watch for leakage between the Valve and its seat.
If the Valve is held up it may be caused by an obstacle between the Valve and its seat or by the Valve itself jamming against its Cage. When testing Valves it is well to see if it is possible for the Valves to jam by trying to make them do so by hand.

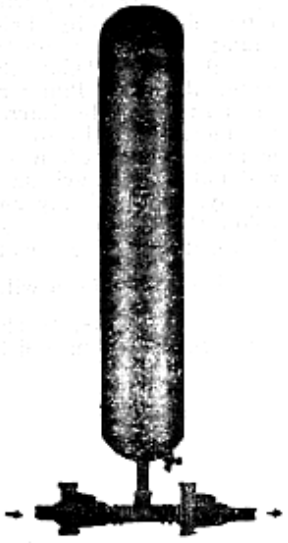
Air Chamber

An air chamber is used to keep the water flowing evenly through the delivery pipe instead of being delivered as separate surges after each up-stroke of the pump. Due to the even flow of water in the delivery pipe, the pump does not have to make a big increase in the rate of flow on each up-stroke, and consequently there is less wear and tear on the pumping plant.

The air chamber should be fitted to the delivery pipe as close as possible to the pump. Where the pump is down a bore, fit the air chamber as close as possible to the top of the bore. A check valve must be fitted on the delivery side of the air chamber to prevent water in the pipe running back when the plug in the air chamber is opened for draining. It is also advisable to fit a check valve on the inlet side of the air chamber in order to relieve the pump valves of the pressure of the chamber.

The air chamber will only be effective while there is air in it to cushion the flow of water. THE AIR CHAMBER IS USELESS IF IT IS FULL OF WATER. Due to pressure in the delivery pipe, the air in the air chamber is gradually absorbed by the water and the air chamber becomes ineffective.

A plug is fitted to the bottom of the air chamber to drain the water from it, and the chamber should be drained periodically. Periods between draining will vary with different installations, and experience will indicate how often it is necessary.



Fitting Air Chamber

Suction Chamber

The purpose of a suction chamber is to provide an even flow of water in the suction pipe to Syphon Pumps instead of a flow which stops on the down-stroke of the pump. The suction chamber also acts as a reservoir and helps supply water which will flow immediately behind the plunger on the up-stroke, and so prevents water hammer. During the downstroke of the pump the water in the suction pipe keeps flowing and replaces the reservoir of water in the suction chamber.

The suction chamber has a cushion of air as in an air chamber, but unlike the air in the air chamber it is not absorbed by the water—instead the size of the air cushion increases. The top should be screwed off the suction chamber periodically and water poured in until the chamber is three-quarters full, leaving one quarter of the chamber as an air cushion. Periods between fillings will vary with different installations, and experience will indicate how often it is necessary.

Parts List for Direct Acting Windmills—"R" Pattern

IT IS IMPORTANT WHEN ORDERING A PART TO GIVE THE MILL NUMBER AND SIZE, AND THE PART NUMBER AND NAME. THE NUMBER OF THE MILL IS STAMPED ON THE WHEEL HUB END OF THE MAIN SHAFT AND ALSO AT THE BOTTOM OF THE MAST PIPE, JUST ABOVE THE TURNTABLE.

17ft. RF	21ft. RG	25ft. RH	No. Off	Name of Part.
RE 1B	RG 1	RG 1	1	Main Casting with Mast Pipe.
RF 2B	RG 2B	RH 2B	1	Crankcase.
RF 3	RG 3B	RH 3B	1	Crankcase Cover.
RF 4	RG 4B	RH 4	1	Wheel Hub.
RF 5	RG 5B	RH 5	1	Bottom Half of Main Bearing.
——	——	RH 6B	1	Front Bearing Cover.
RF 8C	RG 8C	RH 8B	1	Crosshead.
RE 9	RE 9	RE 9	1	Swivel Flange.
RE 10	RE 10	RE 10	1	Stop for Vane Hinge.
RF 11D	RG 11D	RH 11C	1	Connecting Rod (Short Stroke).
RF 12	RG 12	RH 12	1	Vane Hinge Casting.
RF 13D	RG 13D	RH 13C	1	Crank (Short Stroke).
RF 14B	RG 14B	RH 14B	1	Vane Hinge Bearing.
RF 15	RG 15C	RG 15C	1	Turntable Body—3 Post (Roller Type Turntable).
RE 17	RG 17	RG 17	1	Top Tower Casting—3 Post.
RE 18B	RG 18B	RG 18B	1	Top Tower Casting Oil Ring.
RE 19C	RG 19B	RG 19B	1	Pivot (Roller Type Turntable).
RF 20	RG 20	RH 20	1	Top Half of Main Bearing.
RE 21	RG 21	RG 21	1	Pump Rod Guide.
RE 22B	RG 22B	RG 22B	1	Pump Rod Guide Box.
RE 23	RG 23	RG 23	1	Top Tower Casting Cover.
RF 24	RG 24C	RG 24C	1	Large Reefing Pulley (on Top of Slide Bars).
——	AV 26	AV 26	2	Reefing Pulley (on Platform Bracket and Tower Chain Guide).
——	AV 27	AY 27	3	Vane Clip Casting.
RE 28	RG 28	RH 28	1	Vane Stay Clip.
RE 29	RG 29	RH 29	1	Check Chain Clip.
J 29	J 29	J 29	1	Top Reefing Pulley Spindle Washer.
RE 30	RG 30B	RG 30	1	Small Reefing Pulley (on Bottom of Slide Bars).
RE 31C	RG 31B	RG 31B	1	Turntable Roller Race.
RF 32	RG 32	RG 32	1	Pump Rod Guide Box Inspection Plate.
AT 34	AT 34	AY 34	3 Pair	Balance Weight.
RE 36	RG 36	RG 36	3 — 3 Post 4 — 4 Post	Turntable Stop.
AS 37B	AV 37	AV 37	3 — 3 Post 4 — 4 Post	Thrust Block.
RF 39	RF 39	RF 39	1	Vane Hinge Bearing Oil Pipe Collar.
RF 43	RG 43B	RH 43	1	Thrust Collar.
RF 44	RG 44	RG 44	1	Wheel Hub Key — Back.
RF 45	RG 45	RG 45		Wheel Hub Key—Front.
RF 46	RG 46	RH 46		Crank Key.
EE 49	EE 49	EE 49	4	Oil Pump Packing Washer.
RE 50	RE 50	RE 50	1	Cover for Oil Overflow Pipe.
RE 51C	RG 51C	RG 51C	2	Pump Rod Connection.
RF 52	RG 52	RH 52	1	Connecting Rod (Long Stroke).
RF 53	RG 53	RH 53	1	Crank (Long Stroke).
AV 54	AV 54	AV 54	2	Reefing Winch Clip.
AV 55	——	——	2	Small Sheave Pulley (on Platform Bracket and Tower Chain Guide).
RF 56B	RG 56B	RH 56B	1	Main Spindle.
RF 57	RG 57B	RH 57B	1	Slide Bar—Right Hand.
RF 58	RG 58B	RH 58B	1	Slide Bar—Left Hand.
RE 60B	RG 60	RG 60	16-14-14	Turntable Roller (not illustrated).
RE 61B	RE 61B	RE 61B	1	Reefing Pulley Spindle (on Bottom of Slide Bars).
RE 62	RG 62	RG 62	2	Pump Rod Guide Rod.
RE 64	RE 64	RE 64	1	Pump Rod Swivel Washer.
RE 65B	RG 65C	RH 65B	1	Crankpin Washer.
RF 66	RG 66	RG 66	2	Slide Bar Tie Rod.
RE 67B	RG 67B	RH 67	1	Big End Connecting Rod Bush.
RF 68B	RG 68C	RH 68B	1	Small End Connecting Rod Bush.
RF 72	RG 72D	RG 72D	1	Top Reefing Pulley Spindle (on Top of Slide Bars).
RE 73	RG 73	RH 73	1	Crankcase Dowel.
DH 75	DH 75	DH 75	1	Reefing Winch Washer.
RE 75	RG 75B	RG 75B	2	Pump Rod Bars.

PARTS LIST (Continued).

17ft. RF	21ft. RG	25ft. RH	No. Off	Name of Part.
RF 77	RG 77	RH 77	1	Reefing Pulley Bracket Stay.
RE 78	RG 78	RH 78	1	Check Chain Bracket Stay.
AT 95	——	——	2	Vane to Vane Hinge "U" Bolt.
RF100	GC 88	GC 88	1	Pump Rod "U" Bolt.
AT100B	——	——	3	Vane Sheet "U" Bolt.
RF102D	RG102D	RH102D	24-30-36	Fan.
RF108C	RG108B	RH108B	8-10-12	Wheel Arm.
RF109	RG109D	RH109C	1	Reefing Chain.
——	AV110	AX110	5	Vane "U" Bolt.
RF111	RG111	RH111	1	Vane Stay.
RF112	RG112	RH112	1	Check Chain.
RE113	AV113	AX113	1	Check Chain Spring.
RG114	RH114	RJ114	1	Small End Bush "U" Bolt.
RF116	RF116	RH116B	1	Reefing Winch Wire Rope.
RE117	RG117B	RG117B	3 — 3 Post 4 — 4 Post	Turntable Centering Jack.
RF118	RG118	RH118	1	Sheet Iron Cover.
RF119	RG119	RH119	1	Oil Splash Guard.
RE121C	RG121	RH121	1	Rotating Platform Angle (Wheel Side).
RE122C	RG122B	RH122B	1	Rotating Platform Angle (Vane Side).
RE123	RG123	RH123	1	Crankcase Reefing Pulley Bracket.
RE124	RG124	RH124	1	Check Chain Bracket.
RE125B	RG125	RH125	1	Left-hand Rotating Platform Bracket.
RE126B	RG126	RH126	1	Right-hand Rotating Platform Bracket.
RE127	RE127	RE127	1	Platform Ladder.
RE128B	RG128B	RG128B	2	Platform Ladder Stay.
AT129B	AV129	AX129	3	Vane Rib.
RE131	RE131	RE131	1	Spout Pipe for Oil Ring to Crankcase Oil Pipe.
RF132	RG132	RH132	1	Oil Pipe from Oil Ring to Crankcase.
RF134B	RG134B	RH134C	1	Vane Pipe.
RE136	AV135	AV135	1	Distance Pipe for Reefing Pulley Bracket.
RE136	AV136	AV136	1	Distance Pipe for Check Chain Bracket.
RF137C	RG137C	RH137B	1	Pump Rod with Swivel.
RF138	RG138	RH138	1	Stand Pipe in Crankcase.
RE139	RG139B	RG139B	1	Tower Reefing Chain Guide Assembly.
RE140B	RE140B	RE140B	1	Oil Stand Pipe in Top Tower Casting.
RE141	RG141	RH141	3-4-5	Long Rotating Platform Board.
RE142B	RG142	RH142	1	Platform Ladder Support.
RE143	RG143	RH143	1	Diagonal Platform Support.
RF145	AW145	RH145B	1	Vane Sheet.
RE146	RG146	RH146	3-4-4	Short Rotating Platform Board.
RE150	RG150	RG150	1	4 Post Top Tower Casting.
RF151	RG151C	RG151C	1	4 Post Turntable Body (Roller Type Turntable).
RE156	RG156	RG156	1	Oil Overflow Pipe from Top Tower Casting.
RE158	RE158	RE158	1	Oil Pump Lever.
RE159	RE159	RE159	1	Oil Pump Lever Rivet.
RE162	RE162	RE162	1	Oil Pump Connection.
RE163	RE163	RE163	1	Oil Pump Lever Fulcrum.
RF166	RF166	RF166	1	Oil Return Pipe on Pump.
RE167	RE167	RE167	1	Oil Pump Body.
RE169	RE169	RE169	1	Oil Lid.
RF170	RF170	RF170	1	Oil Container.
RE171	RE171	RE171	1	Oil Pump Plunger.
RE172	RE172	RE172	1	Oil Container "U" Bolt.
RE173	RE173	RE173	1	Oil Pump Pipe.
RE174	RE174	RE174	1	Oil Pump Packing Nut.
RF175	RF175	RF175	1	Oil Pump Reducing Bush.
RE176	RE176	RE176	1	Oil Pump Valve Seat.
RE177	RG177	RG177	1	Pump Rod Clamp Plate.
RE178	RG178	RG178	2	Pump Rod Connection "U" Bolt.
RF179	RH179	RH179	3 — 3 Post 4 — 4 Post	Thrust Block Support.
RE180	RG180	RH180	1	Wheel Hub Key Locking Wire.
RF188	RG188	RH188	1	Felt Strip for Crankcase.
RE189	RG189	RG189	1	Felt Strip for Guide Bar Box.
——	——	RH191	1	Felt Strip for Crankcase Cover.
RF194	RG194	RG194	1	Tower Reefing Chain Guide Assembly (4 Post).
——	RG196	RG196	1	Overflow Pipe from Turntable Body.
——	RG197	RG197	1	Overflow Pipe to Guide Box (3 Post).
——	RG198	RG198	1	Overflow Pipe to Guide Box (4 Post).

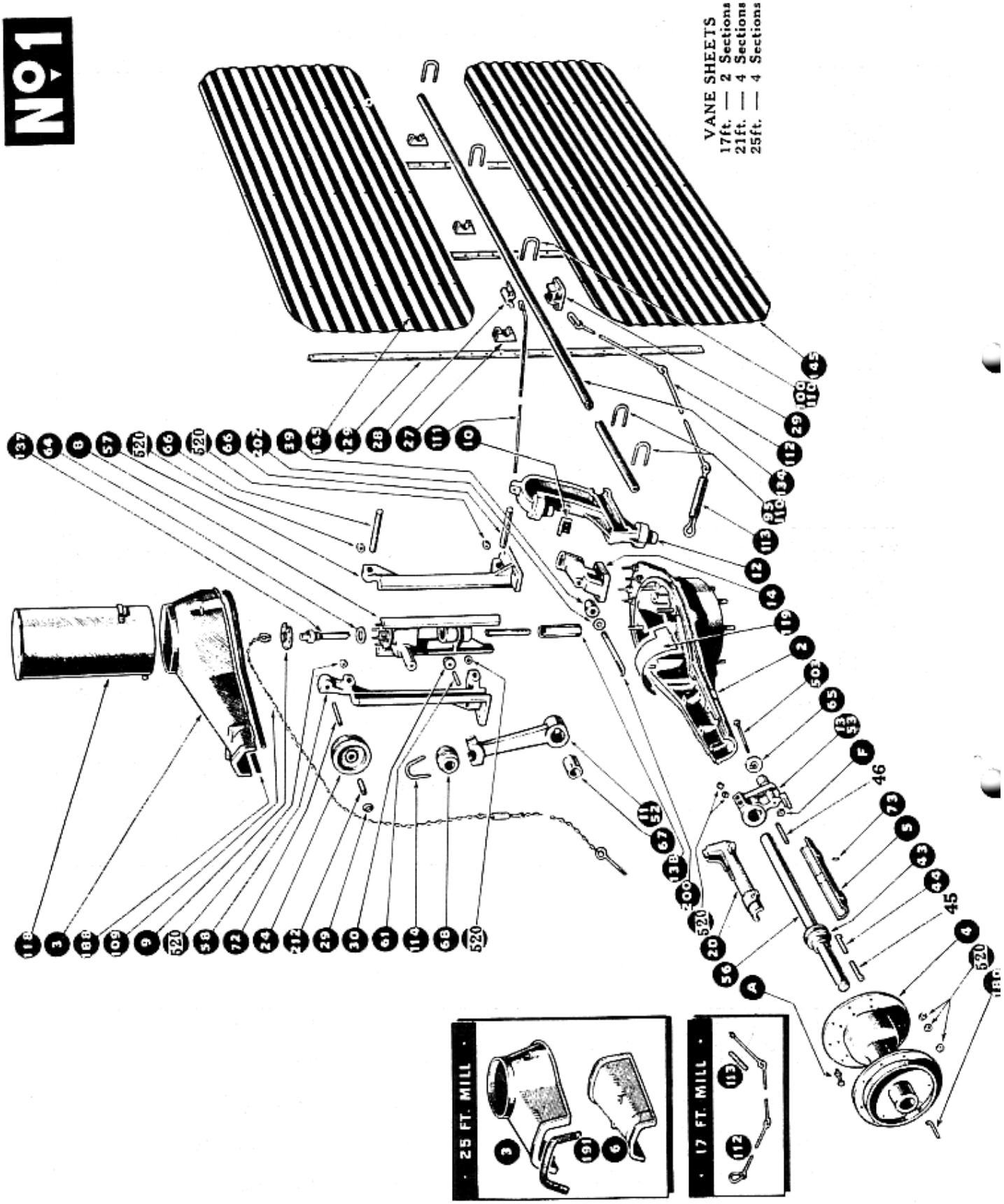
PARTS LIST (Continued).

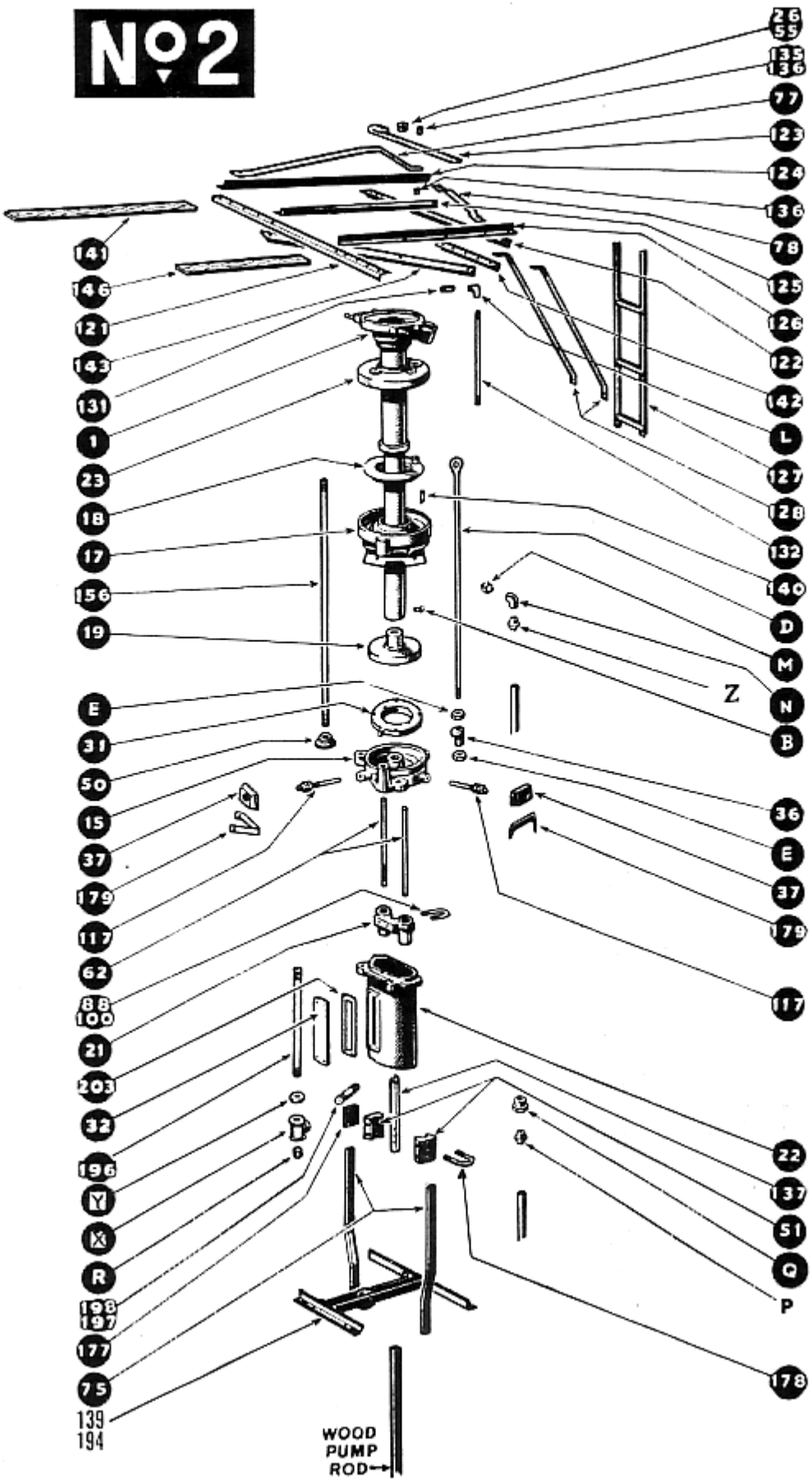
17ft. RF	21ft. RG	25ft. RH	No. Off	Name of Part.
RF200	RG200	RG200	1	Vane Hinge Bearing Oil Pipe.
RF202	RF202	RF202	1	Vane Hinge Bearing Oil Pipe Collar Gasket.
RF203	RG203	RG203	1	Pump Rod Guide Box Inspection Plate Gasket.
RF212	RG212	RG212	1	Large Reefing Pulley Bush.
RF217	RF217	RF217	1	Reefing Winch Body.
RF218	RF218	RF218	1	Reefing Winch Drum.
RF219	RF219	RF219	1	Reefing Winch Gear.
RF220	RF220	RF220	1	Reefing Winch Worm.
RF221	RF221	RF221	1	Reefing Winch Handle.
RF222	RF222	RF222	1	Reefing Winch Gear Rivet.
RF223	**RG223**	**RG223**	1	Top Tower Casting Cover Seal.
RF250	RG250	RH250	8-10-12	Section of Wheel Outer Ring.
RF251	RG251	RH251	8-10-12	Section of Wheel Intermediate Ring.
RF252	RG252	RH252	8-10-12	Section of Wheel Inner Ring.
RF254	RF254	RF254	24-30-36	Fan Outer Bracket.
RF255	RF255	RF255	24-30-36	Fan Intermediate Bracket.
RF256	RF256	RF256	24-30-36	Fan Inner Bracket.
RF258	RF258	RF258	24-30-36	Fan Outer Bracket Stay.
RF259	RF259	RF259	24-30-36	Fan Intermediate Bracket Stay.
RF520	**RF520**	RF520	2-3-4	Wheel Hub Locking Screw.
			4	Slide Bar Tie Rod Locking Screw.
			2-4-4	Crank Locking Screw.
RF503	RG503B	RH503B	1	Crankpin Bolt.

A. Wheel Arm Hub Bolt—1¼in. x ⅝in., 17ft.; 1⅜in. x ⅛in., 21ft. and 25ft.; Galv. High Tensile Steel Bolt.
B. Pivot Setscrews—⅜in. x ⅛in., 17ft.; 1in. x ⅝in., 21ft. and 25ft.; M.S. Bolt without Nut.
C. Oil Pump Lever Fulcrum Setscrew—1in. x ⅜in. Whit.
D. Suspension Strap.
E. Suspension Strap Nut—⅜in., 17ft.; 1in., 21ft. and 25ft.; M.S. Nut.
F. Crankpin Bolt Nut—⅛in., 17ft. and 21ft.; ⅝in., 25ft.; M.S. Slotted Hex. Nut.
J. Oil Pump Valve—⅜in. Dia. Steel Ball.
L. Oil Ring to Crankcase Pipe Elbow—⅜in. F. & F. Elbow.
M. Oil Supply Pipe Nipple—¼in. to ⅜in. Galv. Pipe Reducing Nipple.
N. Oil Supply Pipe Elbow—¼in. Galv. Pipe Elbow F. & F.
Q. Guide Box Reducing Bush—1in. to ⅜in. Galv. Pipe Reducing Bush.
T. Reefing Wire Thimble—No. 4, 17ft. and 21ft.; No. 5, 25ft.
U. Reefing Wire Rope Clip—¼in., 17ft. and 21ft.; 5/16in., 25ft.
V. Pullout Wire—⅜in. Circum., 17ft. and 21ft.; 1in. Circum., 25ft.
Z. Oil Supply Pipe Connection—¼in. P. to ¼in. M.I. End Connector.
X Overflow Pipe Tee—1in. Galv. Tee, 21ft. and 25ft.
Y Overflow Pipe Backnut—1in. Galv. Backnut, 21ft. and 25ft.
R Overflow Pipe Plug—1in. B.S.P. Galv. Plug, 21ft. and 25ft.
P. Oil Return Pipe Connection—⅜in. P. to ⅜in. M.I. End Connector.

CONNECTING RODS AND CRANKS.

17ft.	21ft.	25ft.	No. Off	Name of Part.
RF 13D 7in. Stroke	RG 13D 8¼in. Stroke	RH 13C 9½in. Stroke	1	Crank (Short Stroke).
RF 53 8in. Stroke	RG 53 10in. Stroke	RH 53 12in. Stroke	1	Crank (Special Stroke).
RF 11D 7in. Stroke	RG 11D 8¼in. Stroke	RH 11C 9½in. Stroke	1	Connecting Rod (Short Stroke).
RF 52 8in. Stroke	RG 52 10in. Stroke	RH 52 12in. Stroke	1	Connecting Rod (Special Stroke).


No 1
VANE SHEETS
17ft. — 2 Sections
21ft. — 4 Sections
25ft. — 4 Sections
25 FT. MILL
17 FT. MILL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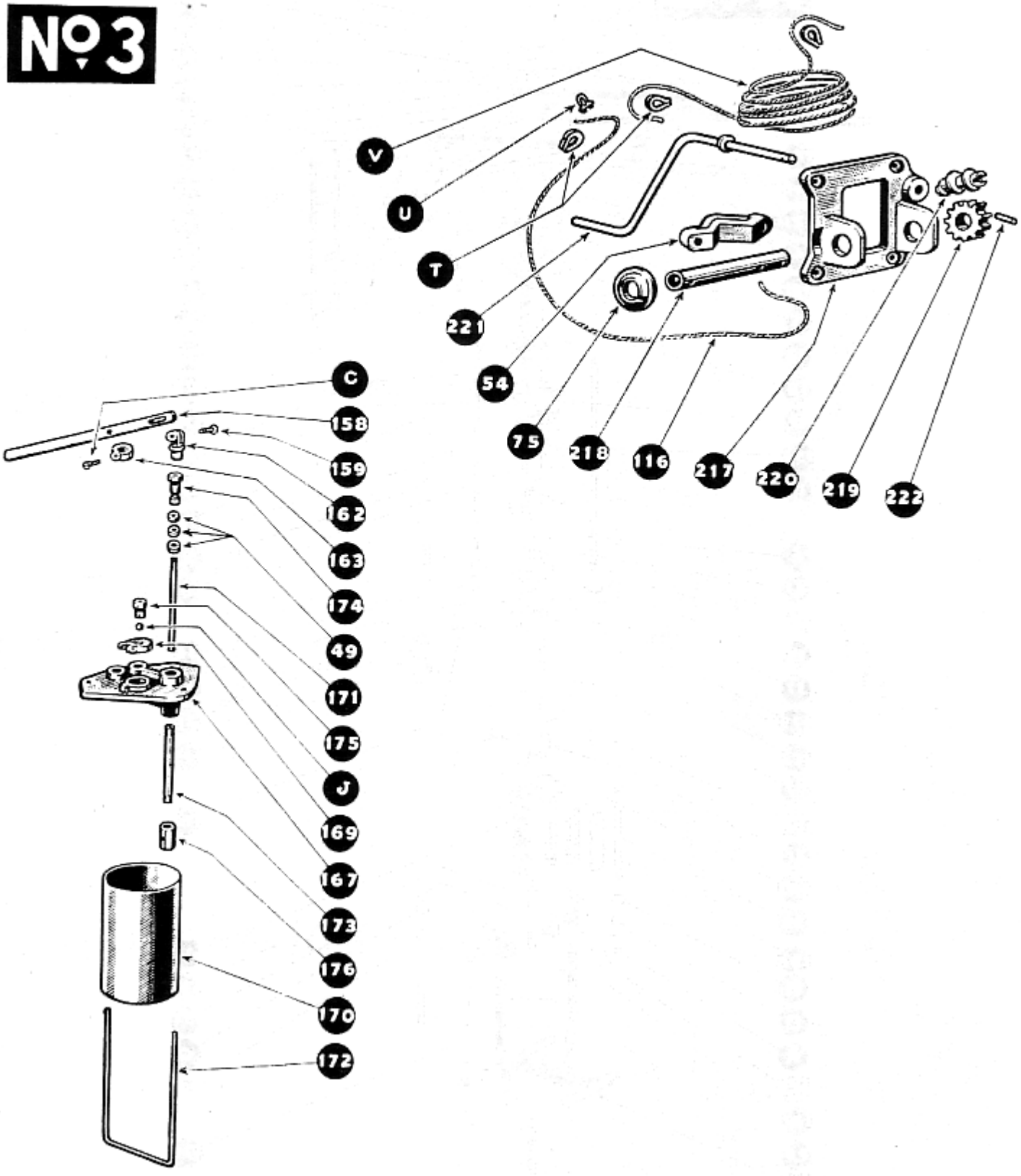
No. 3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