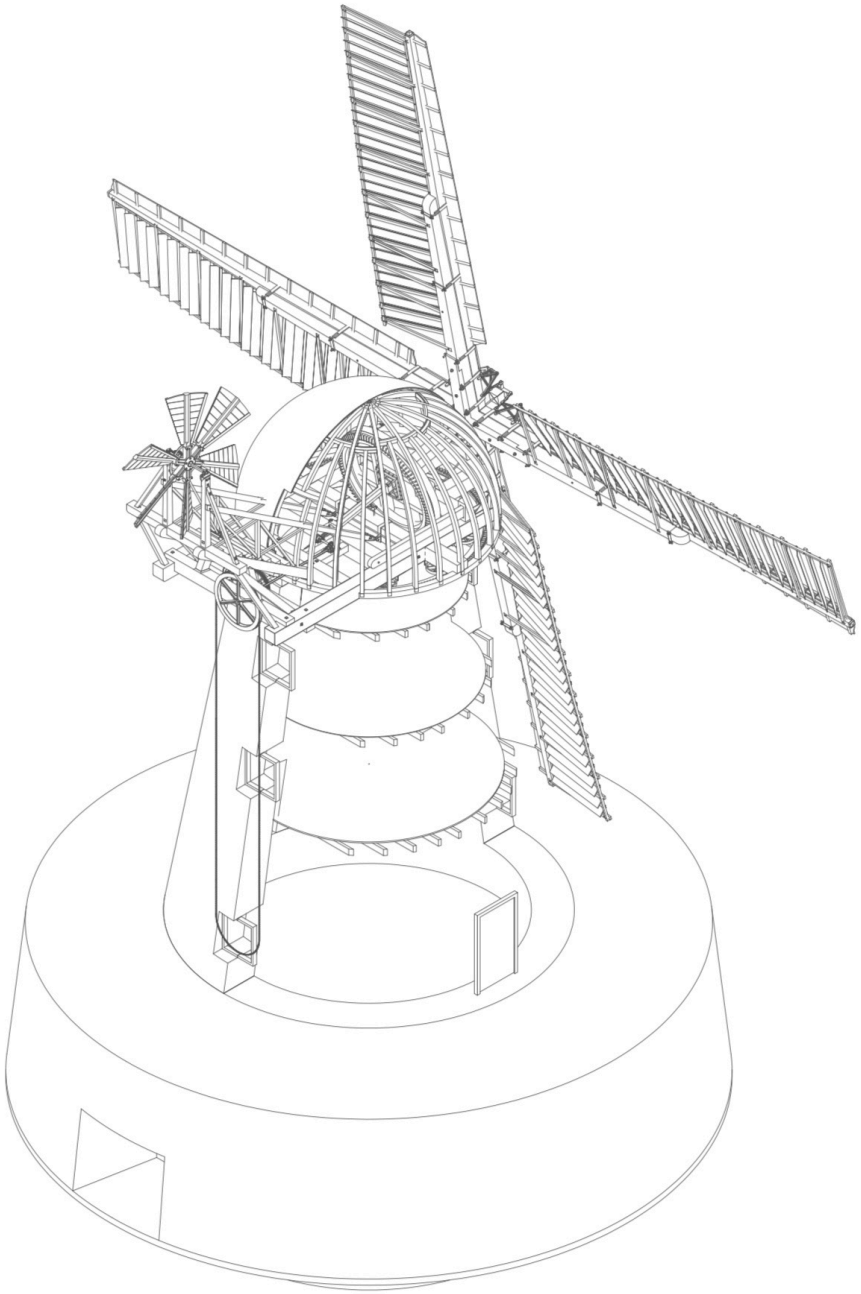
Sunderland City Council

FULWELL WINDMILL
Sunderland

User manual - draft 2
BMHC May 2018



CONTENTS

PART 1: OPERATING THE MILL

1.1 External checks on arrival

On arriving at the mill, it is important to check externally that all appears normal. Spend a few minutes doing this.

First, view the exterior of the mill from all sides at ground level. Then, ascend the stairs internally and climb to cap level. With a colleague, open the front and rear hatches of the cap to admit more light and check the upper parts at closer quarters from inside the cap.

- Is the door at ground level secure, with no signs of damage or forced entry?
- Is the door at first floor level secure, with no signs of damage or forced entry?
- Does the fantail appear to be operating normally?
- Are there any squeaks or knocking noises coming from the fantail, sails or cap that appear unusual?
- Is there any loose or flapping woodwork on the petticoat or sails?
- Do any of the sail shutters appear to be loose, flapping or at a strange angle?
- Do any of the metal parts on the sails and fan stage appear loose or at a strange angle?
- Are any chains or ropes, which should be coiled up, hanging loosely or caught on window sills?

If you have any concerns, discuss these with a colleague before entering the mill. If there any obvious problems, contact the millwright immediately and then - from a safe distance - take photos on a mobile phone so these can be emailed to the millwright to inform him of the problem, if needed.

1.2 Internal checks on arrival

Before you enter the mill, inform SNCBC of your whereabouts. Always carry out the initial checks and setup with another person.

When opening up the mill, first check that the electrical supply and lights are working correctly. Turn on the lights and check these are working on all floors as you ascend.

Structural parts

- Check staircases for damage as you ascend.
- Check staircase handrails for damage / loose parts as you ascend.
- Check all floorboards on first, second and third floors are secure as you ascend.
- Check windows and doors are undamaged as you ascend.

Mechanical parts

GROUND FLOOR

- Do the spouts and equipment appear to be complete?

FIRST FLOOR

- Is all guarding secure and in place?
- Are the gears and equipment in place?

SECOND FLOOR

- Is all guarding secure and in place?
- Are the two stone nuts and auxiliary drive nut disengaged from the great spur wheel?
- Is there anything in the way that could stop the central upright shaft from turning?

THIRD FLOOR

- Is all guarding secure and in place?
- Is there anything in the way that could stop the central upright shaft from turning?

FOURTH FLOOR

- Is all guarding secure and in place?
- Is the grain bin intact and free of debris?

CURB

The curb is the junction between the stationary lower part of the mill and the rotating cap roof which is always able to turn - often without warning - when the wind changes direction.

As you ascend into the cap, check there is nothing unusual hanging down or loose that could get caught in the working parts and cause a problem.

The metal track (which the cap skid blocks slide around on) is lightly greased but should always be clear of dirt, nuts and bolts, birds' nests and other debris. Any mess or items that clearly should not be there must be extracted if possible, but only if the wind is calm and it is safe to do so.

Remember that the cap may start to turn and move around the track without warning, so do not place any limbs, any large tools or pieces of timber close to any of the rollers, or they risk getting crushed. The same applies to the six horizontal wheels which centre the cap on the tower. These could pinch a hand or a tool if placed close by, so please don't.

CAP

- Are there any leaks through the cladding?
- Are ropes and chains coiled up securely?
- Are all tools and pieces of equipment stowed correctly, away from any working parts?
- Does the fantail gearing appear to be operating correctly?

If everything appears to be in order, the mill can be set up for operation.

1.3 Setting up for operation

Refer to drawing below. In outline, the procedure is:

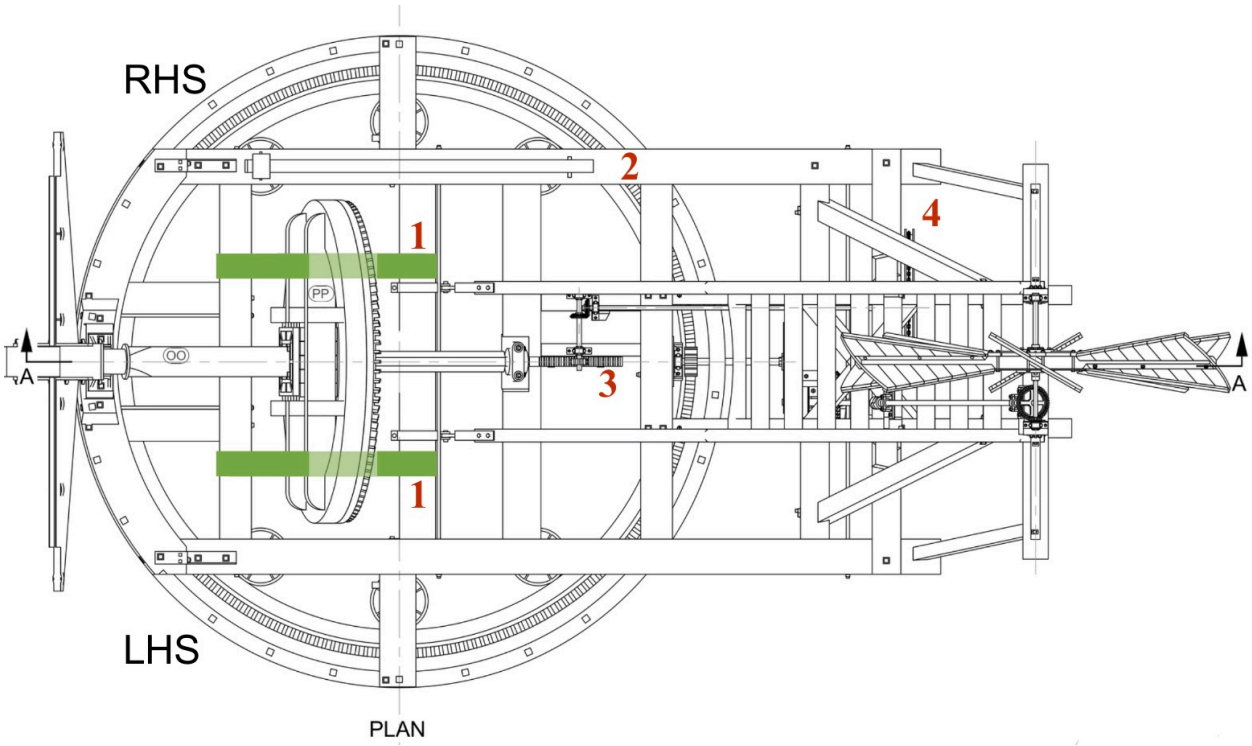
1. (In the cap) Remove sprags and sprag wedges from brake wheel. The sprags are long pieces of timber which pass through the arms of the wheel and are wedged downwards against the cap frame, preventing the sails from turning in very high winds. The sprags must be placed securely at the outer edges of the cap frame, so they cannot move. UNTIL THE SPRAGS ARE INSTALLED, TEMPORARY LORRY STRAPS HOLD THE BRAKE WHEEL STATIONARY. REMOVE THESE.

2. (In the cap) Uncoil the brake rope, which is coiled up and stowed inside the rear RH corner of the cap. Ensure it runs over the guide pulley so it falls down outside the tower to ground level, clearing the curb teeth. If possible, lift the brake lever a little way using the rope to ensure it is working correctly.

3. (In the cap) Check the rack and pinion at the rear of the windshaft are unobstructed.

4. (At ground level) Ensure the striking chain hangs freely from the striking wheel.

All should now be ready to start the mill.



1.4 Starting the mill using the brake

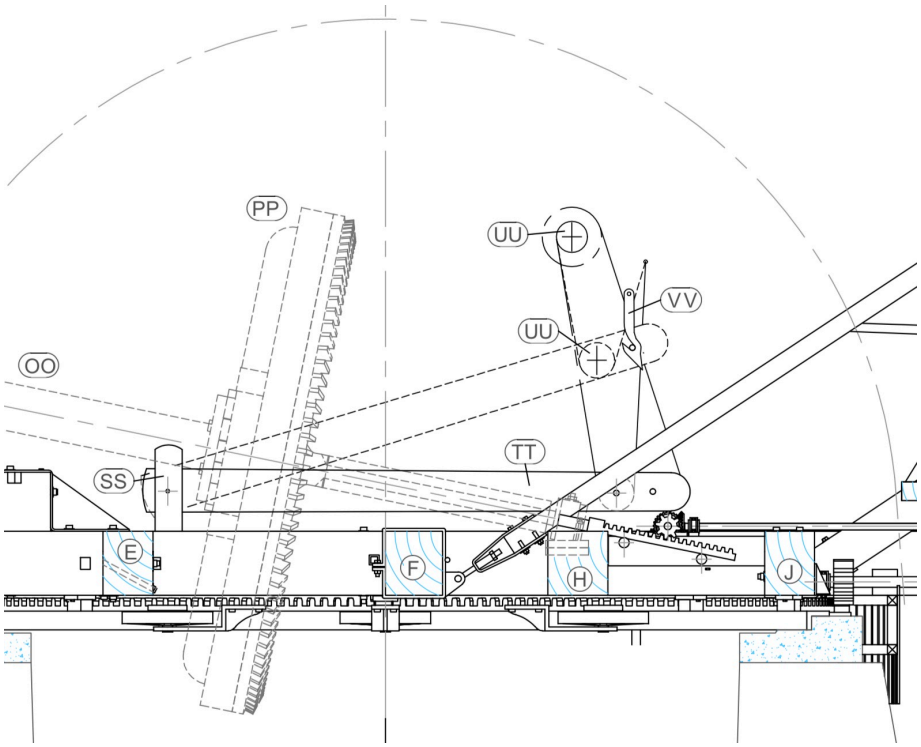
Operating the mill requires a combination of visual observation, listening, and muscle memory. With practice, running the mill and being alert to potential problems will become second nature.

TUITION IN OPERATING THE BRAKE WILL BE PROVIDED. DO NOT OPERATE THE BRAKE UNLESS YOU HAVE RECEIVED TUITION AND ARE APPROVED TO SO.

At ground level:

- Taking hold of the brake rope, pull the rope downwards for a distance of about 3 feet (just short of a metre) until it cannot be pulled further. There should be a loud 'clunk' from the cap. **Do not let go of the rope**.
- Holding the rope tightly, lower it about 1 foot (30 centimetres) until there is another 'clunk' from the cap. This indicates that the brake lever is being held by the catch. The brake is 'off'.
- If the rope can be lowered further than 1 foot, the lever hasn't caught in the catch and the brake will still be 'on'. A colleague, located in the cap, should verify this.

When the brake is 'off', the sails will start to turn slowly if the wind is strong enough. To adjust the speed of the sails, the sail shutters can be opened or closed.



Key:

SS = Brake lever stanchion

TT = Brake lever in 'on' position

VV = Swinging catch to hold brake lever in 'off' position

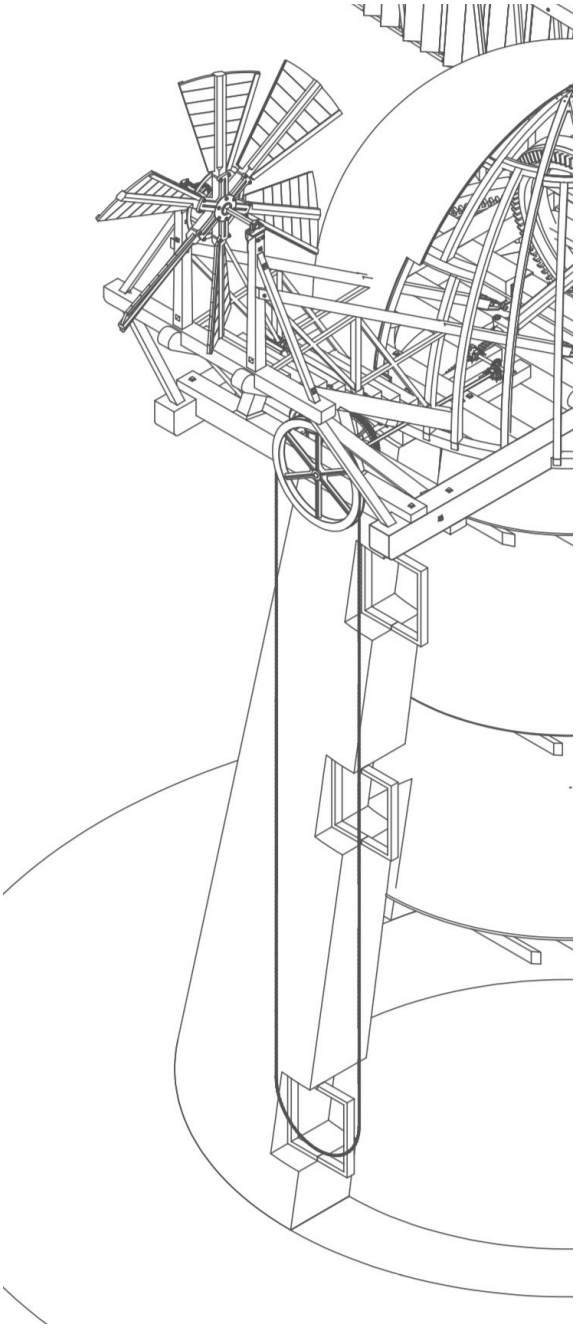
UU = Bollard with pulley wheel around which brake rope is wound

1.5 Operating the sail shutters

TUITION IN OPERATING THE SAIL SHUTTERS WILL BE PROVIDED. DO NOT OPERATE THE SAIL SHUTTERS UNLESS YOU HAVE RECEIVED TUITION AND ARE APPROVED TO SO.

At ground level:

- Taking hold of the left part of the striking chain loop, pull the striking chain to rotate the purchase wheel. This will draw the striking rod forwards, closing the shutters in the sails. A ‘clunk’ indicates that the shutters are fully closed. Closing the shutters will increase the speed of the sails.
- The shutters can be made to stay closed by hanging a weight on the left side of the loop of the striking chain. A small amount of weight is sufficient to do this. Using an S-hook, hang a small weight on the rear loop of the chain at shoulder height once the shutters have been closed.
- During strong gusts, the wind will overcome the weight on the chain by blowing the shutters open, reducing the speed of the sails automatically. Note: The weight on the chain will move sharply upwards, out of reach, when this happens.
- As the gust subsides, the weight will gradually overcome the wind pressure and pull the chain downwards, closing the shutters again.
- To open the shutters, remove the S-hook and weight and pull on the right side of the loop of the striking chain. With the shutters open, the sails will gradually slow down, and may stop.



How fast should the sails rotate?

The sails should rotate at a maximum of 15rpm (one sail passing the window every second). If the sails are beginning to rotate too fast, simply open the shutters fully.

1.6 Stopping the mill using the brake

TUITION IN OPERATING THE BRAKE WILL BE PROVIDED. DO NOT OPERATE THE BRAKE UNLESS YOU HAVE RECEIVED TUITION AND ARE APPROVED TO SO.

If the wind is strong enough, the sails may still be turning when the shutters have been opened. The brake must then be used to bring the sails to a halt.

The brake is **very effective**, so **great care** must be taken when using it **whilst the sails are turning**. If the brake is applied too quickly, it will 'snatch' at the brake wheel, instantly halting the sails. This risks damage to the sails or the other working parts, which can be difficult and costly to rectify.

To operate the brake safely, keep a firm hold of the brake rope at all times. The aim is to jerk the lever off the catch and then gradually release the rope - hand over hand - so that the brake is smoothly applied to the brake wheel. This will bring the sails to a halt gradually.

- A colleague should ascend to the cap first of all to check the operation of the brake lever.
- A sharp pull on the brake rope will jerk the catch away from the hook on the brake lever.
- The brake lever must then be lowered away from the catch before it swings back and engages the hook. These two actions should be combined into one fluid movement.
- Keeping hold of the brake rope, slowly pay out the rope to apply the brake gradually.
- When the brake rope is fully paid out, the brake should be 'on'. A final, gentle pull on the rope will confirm this.
- After bringing the sails to a halt, ascend into the cap and check the brake wheel and brake mechanism to confirm all is in order. The mill can then be made safe for a longer period.

1.7 Making the mill safe

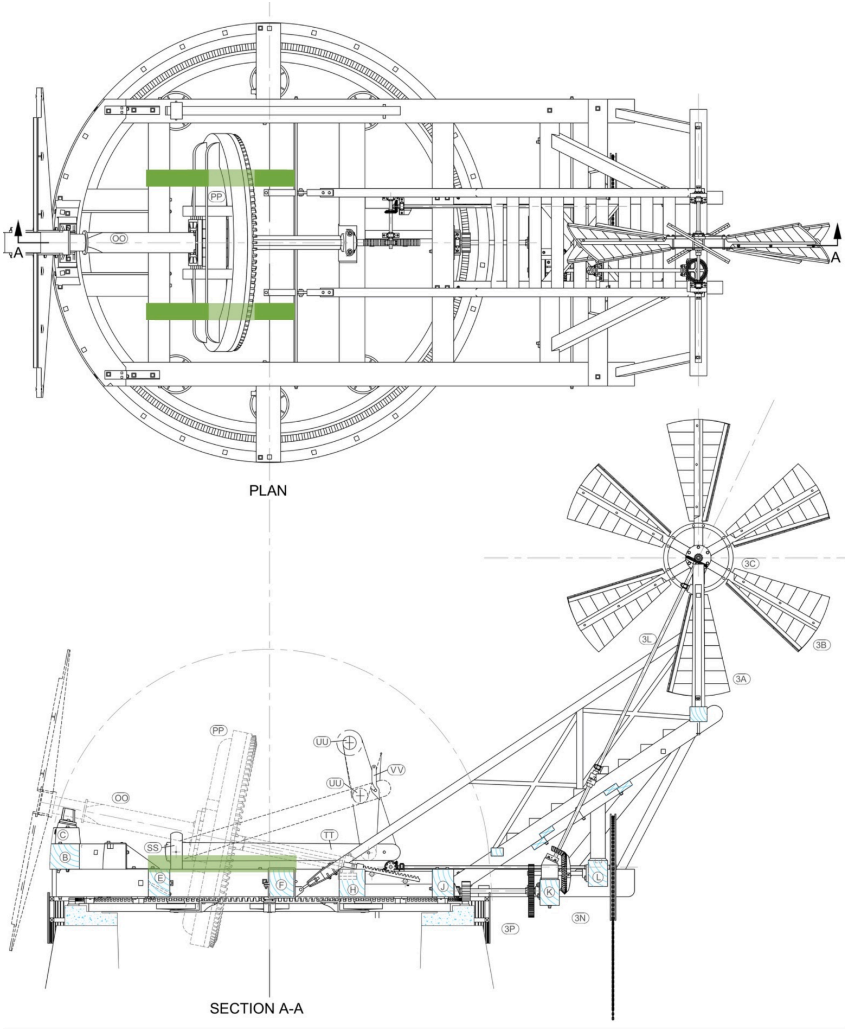
1. (In the cap) With the rear hatch open, pull up the hand rope to shorten the striking chain loop. Tie it off securely. This will prevent the chain from swinging about in windy conditions and catching on the window sills.

2. (In the cap) Haul up the brake rope and coil it up, securing it with some thin rope if possible. Place the coil on a flat timber, ensuring the free end is not left flapping so it cannot get caught in any moving parts.

3. UNTIL THE SPRAGS ARE INSTALLED, RE-FIT THE LORRY STRAPS TO SECURE THE BRAKE WHEEL (In the cap) With an assistant, carefully lift the sprags into place and thread them through the brake wheel. Ensure the brake wheel is rotated to a suitable position so the sprags pass through correctly and rest on the timbers behind and in front of the wheel.

4. (In the cap) Using oak wedges and spacing blocks, wedge between the sprags and the arms of the brake wheel on **both** sides of the windshaft. This ensures the wheel cannot rotate either backwards or forwards without first removing the sprags. The wedges should be hammered in tightly so the sprags cannot be moved if pushed or kicked.

SPRAG POSITIONS shown in green >



1.8 Procedure in high winds

Provided the steps 1-5 in Section 1.7 above have been followed, the mill should be safe to withstand the highest of wind speeds.

It is safest to stay away from the immediate area of the mill during high winds (above no. 7 on Beaufort Scale).

Once the wind has died down to a safe speed, carry out the external checks listed in Section 1.1.

If any damage is identified or suspected, inform the millwright immediately.

1.9 Troubleshooting

Below are a few common problems. Do not attempt to rectify these unless it is safe to do so and you are sure what the problem is. In high wind conditions, never attempt to rectify any problems. If in doubt, always contact the millwright.

Fantail is squeaking as it rotates

One of the bearings is likely to require greasing. Generally, the bearings on the fantail spindle and down shaft squeak more often than the others because they are making more revolutions. Refer to maintenance plan. Inform the millwright.

Fantail is making clonking noises

This could signify that some of the gears are coming out of mesh because of increased resistance in the system. Identify where the clonking is coming from, if safe to do so, and inform the millwright.

Fantail is turning but cap is not

It may or may not be making clonking noises. Either way, some of the cogs are out of gear. Inform the millwright.

Cap is creaking as it turns to wind

This is natural. It may creak when facing some directions but not others. Try and identify the source of the noises and look for loose fixings. Make a note of the problem in the log book.

Striking gear is very stiff to operate

There could be a problem with one of the bearings (lack of oil/grease), or misalignment in the front or rear striking gear somewhere. One of the sail shutters could be damaged or jammed, preventing movement. Investigate cautiously if safe to do so, but do not attempt to overcome the problem with more force, as this can often cause further damage. Everything should work smoothly with a minimum of force. Inform the millwright.

Sail shutters (vanes) are stuck open or closed

As above. Do not attempt to overcome the problem with more force. Inform the millwright.

Brake cannot be operated / released from the ground

The brake lever may be stuck in one position, or slightly misaligned. Ascend to the cap and investigate, leaving a colleague on the ground to operate the rope. If problem persists, make a note in the log book and contact the millwright. Continue to use the brake only if it can be safely released and applied. If not, do not use until the millwright has visited.

Cogs (wooden teeth) in brake wheel / other gears are loose or damaged

The mill should not be operated with damaged or missing cogs. Make a note in the log book and inform the millwright.

Wedges to brake wheel or other gear wheels are loose

The wooden wedges must be kept tight, but seasonal movement sometimes means they become loose and move or fall out. Make a detailed inspection and tighten the wedges if possible. If you suspect one or more gear wheels have moved on their shafts, do not attempt to operate the mill. Make a note in the log book and inform the millwright.

Fixings to internal or external timbers are loose

Fixings must be kept tight to ensure structural and mechanical integrity of the working parts. Seasonal movement means timber can shrink and fixings can become loose. Keep an eye open at all times for loose fixings. If these can be tightened safely, do so, and make a note in the log book. If you have concerns, inform the millwright.

Procedure if high winds are predicted

- The mill custodian should be aware of the local weather forecast at all times, so all those involved with looking after the mill are given as much notice as possible if high winds / weather events are predicted.
- Provided the regular maintenance plan is being adhered to, and the mill has been made safe by following the steps in Section 1.7, all should be well.
- During high wind conditions, do not attempt to enter the mill to rectify any problems. If problems are suspected, or observed from a safe distance, inform the millwright immediately.

Stopping the mill in an emergency

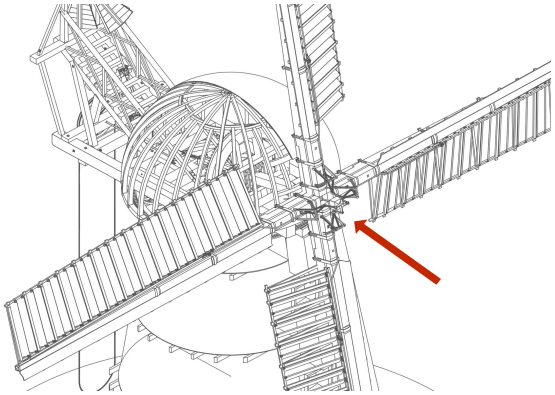
- It is important to remember that **trying to stop the mill quickly** will do more harm than good.

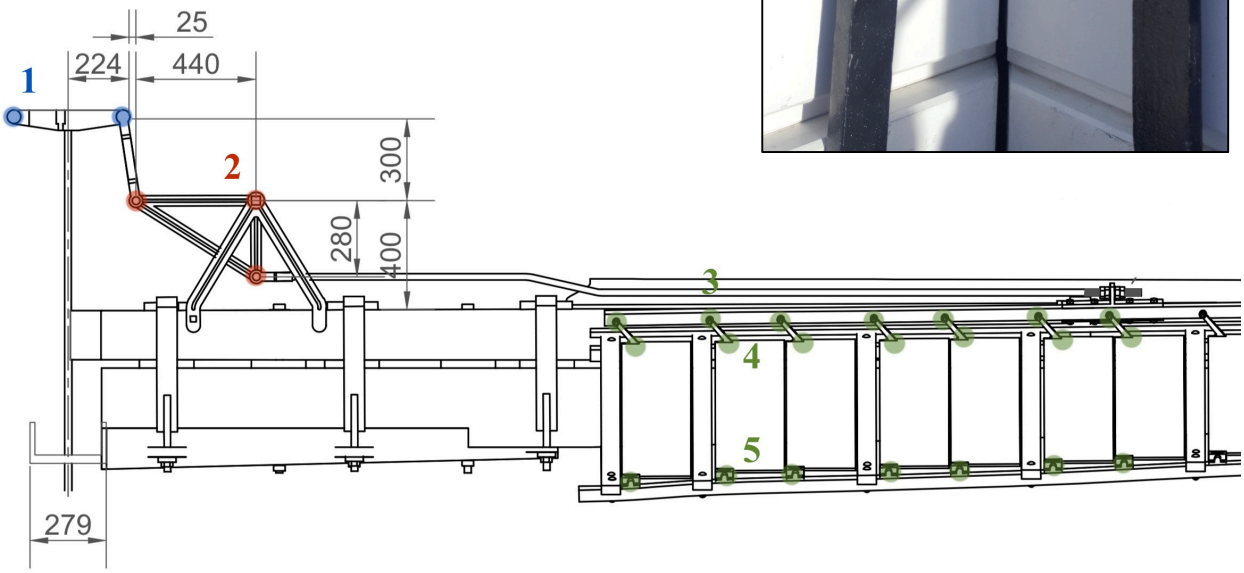
The mill is not designed to stop instantly, and trying to do so is likely to cause **major damage**.

- To bring the sails to a halt, ALWAYS open the shutters fully (Section 1.5) before applying the brake (Section 1.6). ALWAYS apply the brake slowly and carefully.

PART 2: MAINTENANCE AND INSPECTION

2.1 Sail shutters and front striking gear





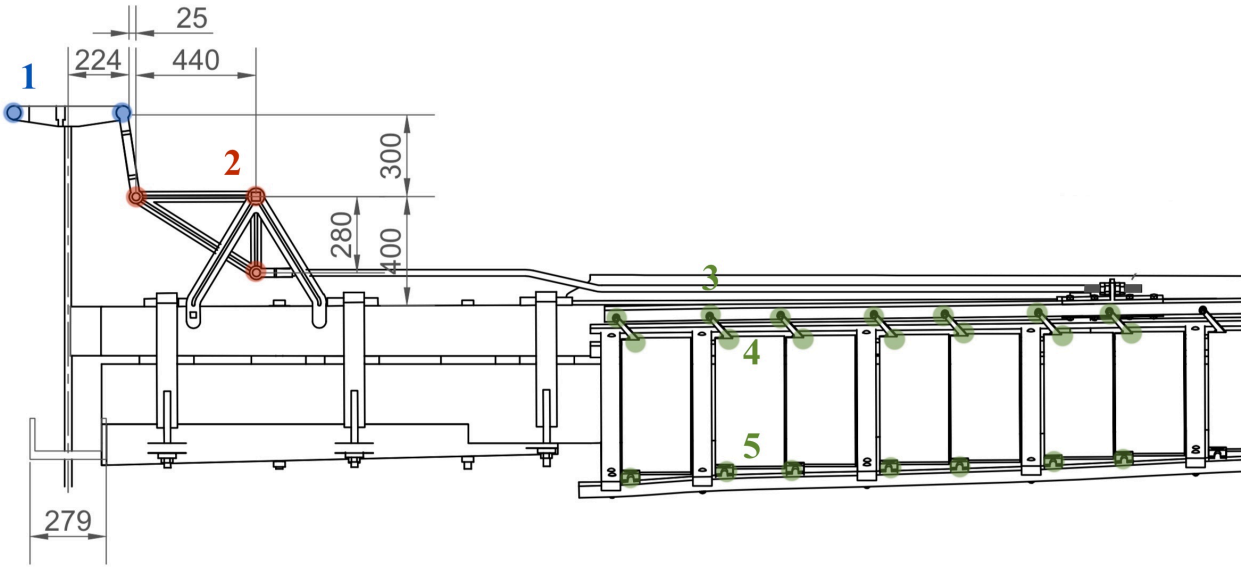
Key:

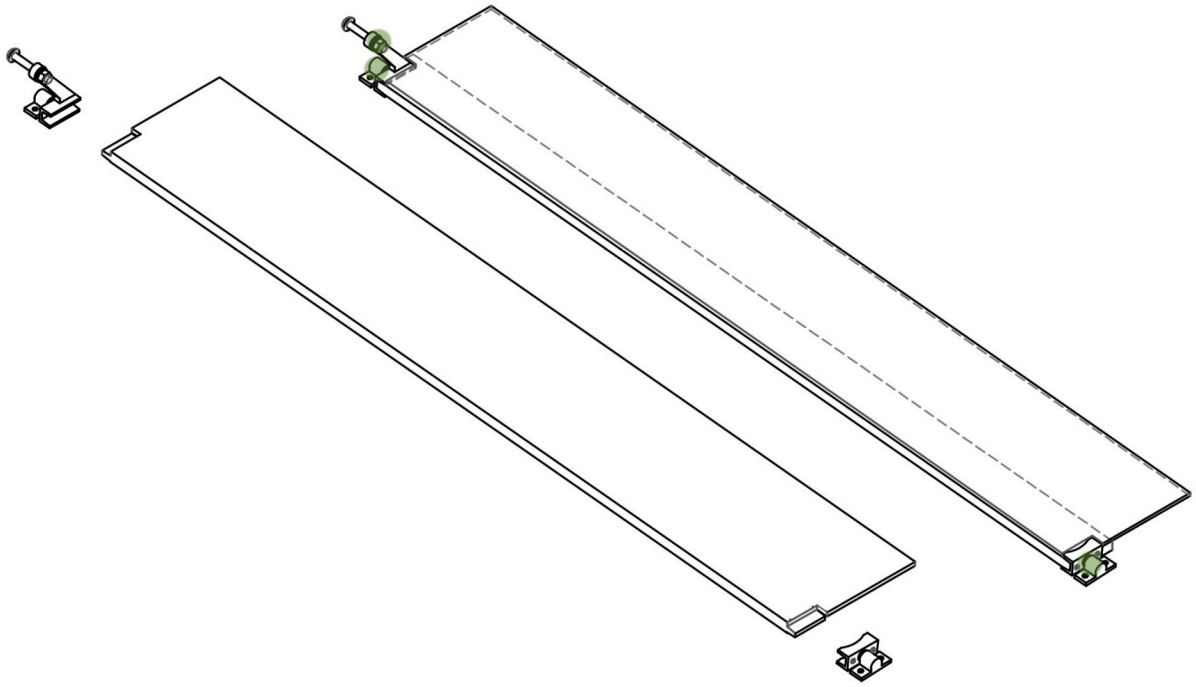
Blue and red circles show greasing points on spider coupling and triangles.

1 = Blue circles show pivots of spider coupling and rein iron at centre of sails.
(Repeat for all four sails.)

2 = Red circles show triangle pivots. (Repeat for all four sails.)

2.1 Sail shutters and front striking gear (continued)



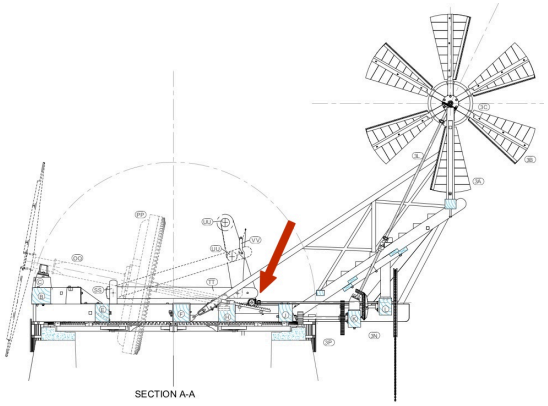


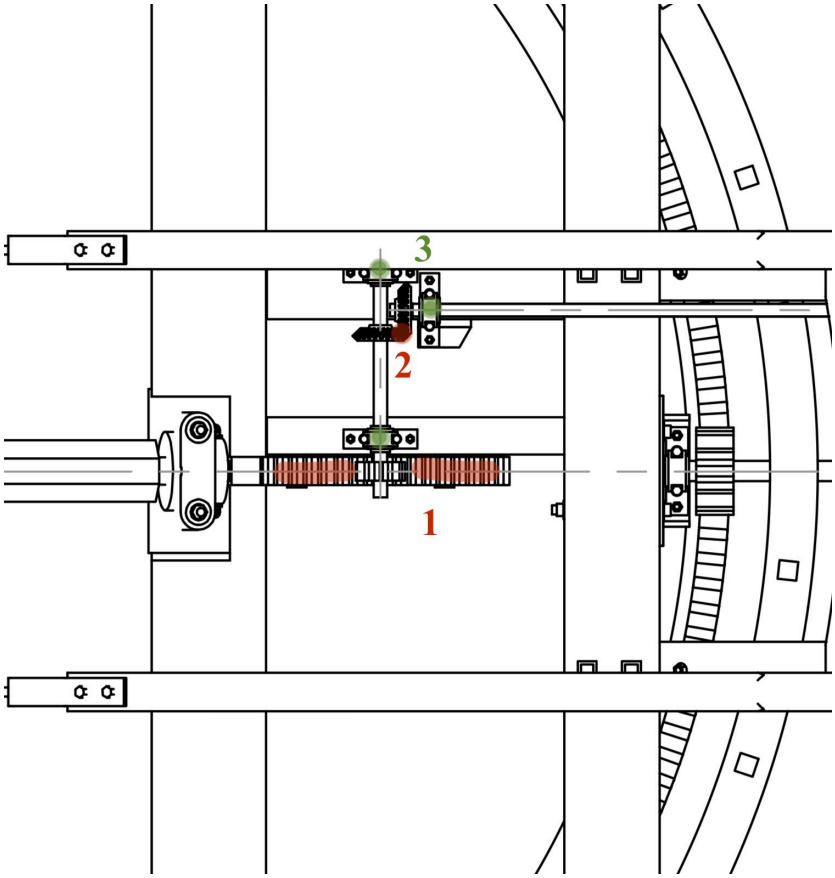
Green circles show greasing points on sail shutters.

3 = Outer hinge of shutter
4 = Inner hinge of shutter
5 = Lever of shutter and connection with working uplong

(Repeat for all shutters in all four sails.)

2.2 Rear striking gear – inside cap

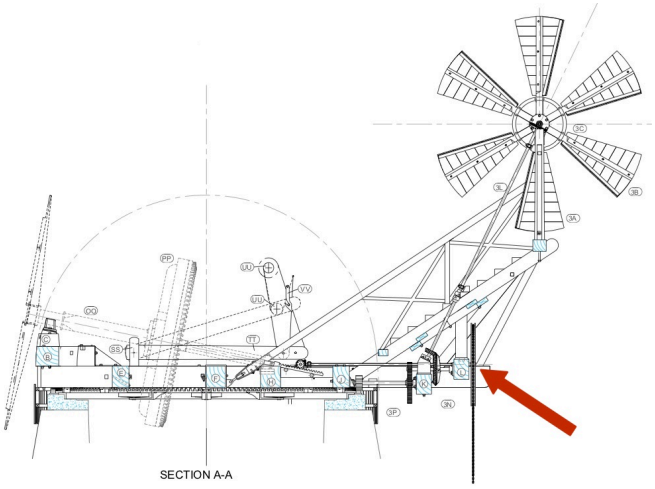


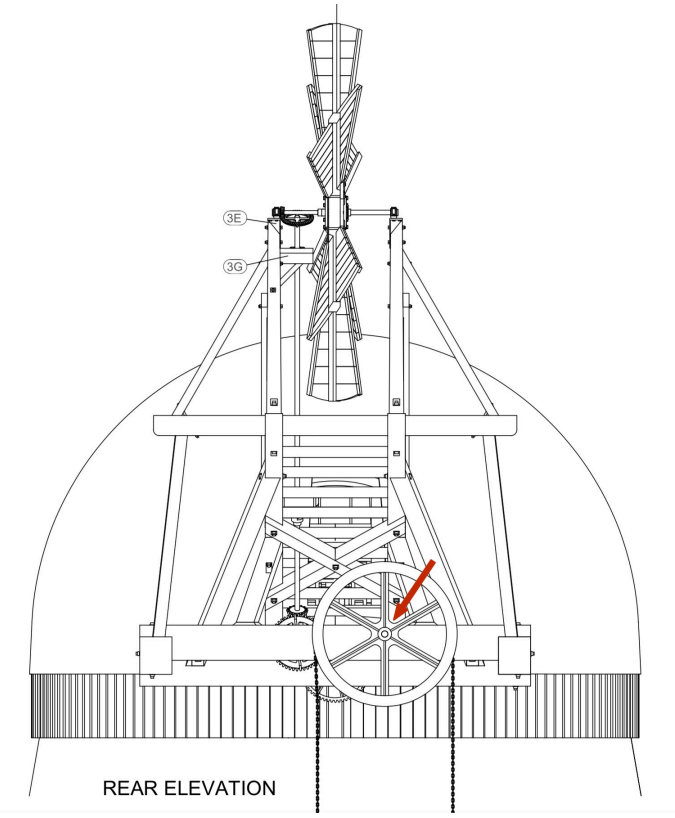


Key:

1 = Rack and pinion require greasing, shown in red
2 = Bevel gear teeth require greasing, shown in red
3 = Bearings require greasing, shown in green

2.3 Rear striking gear – outside cap



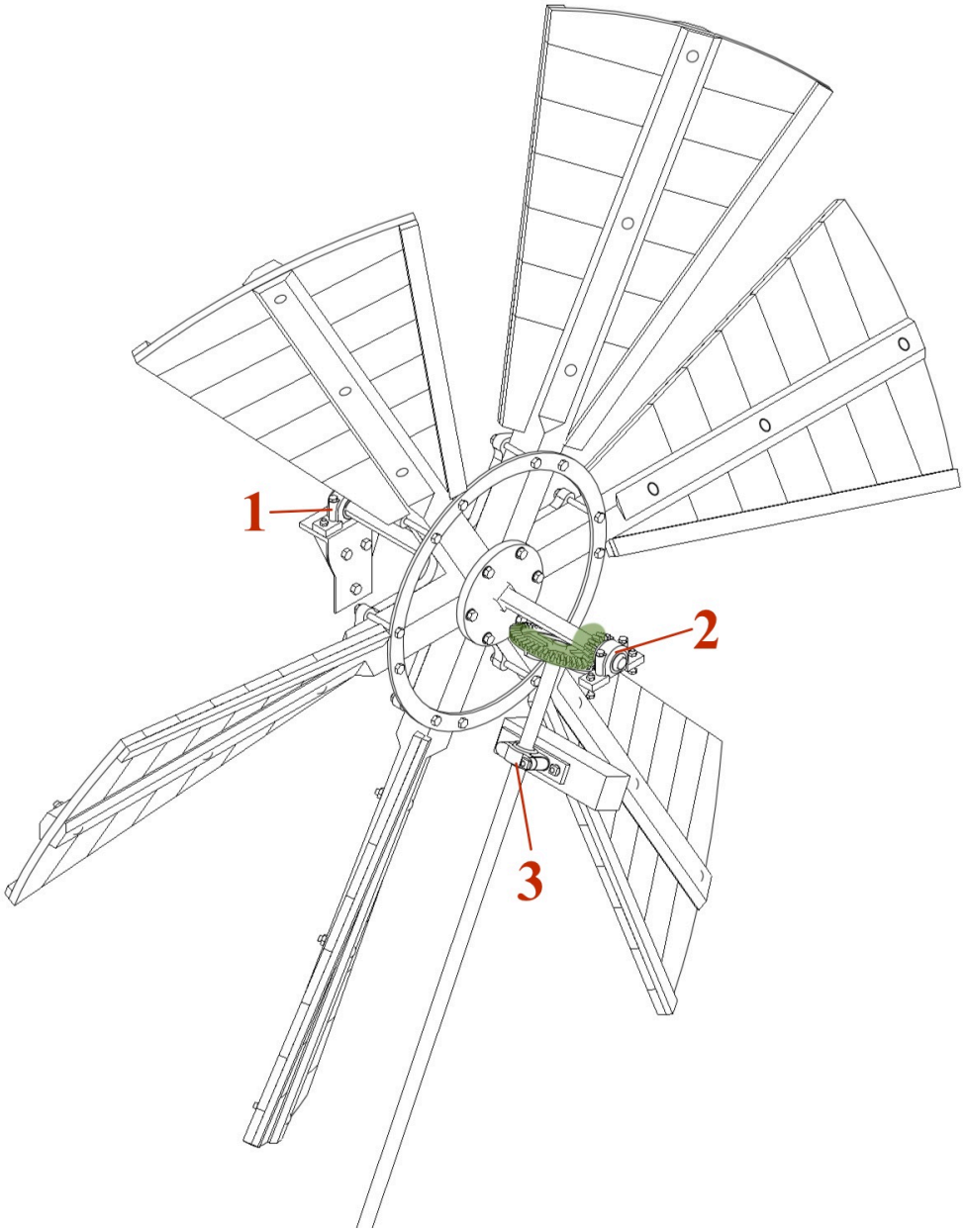


Key:

Outer bearing of striking wheel shaft requires greasing

2.4 Fantail gearing

FANTAIL SPINDLE



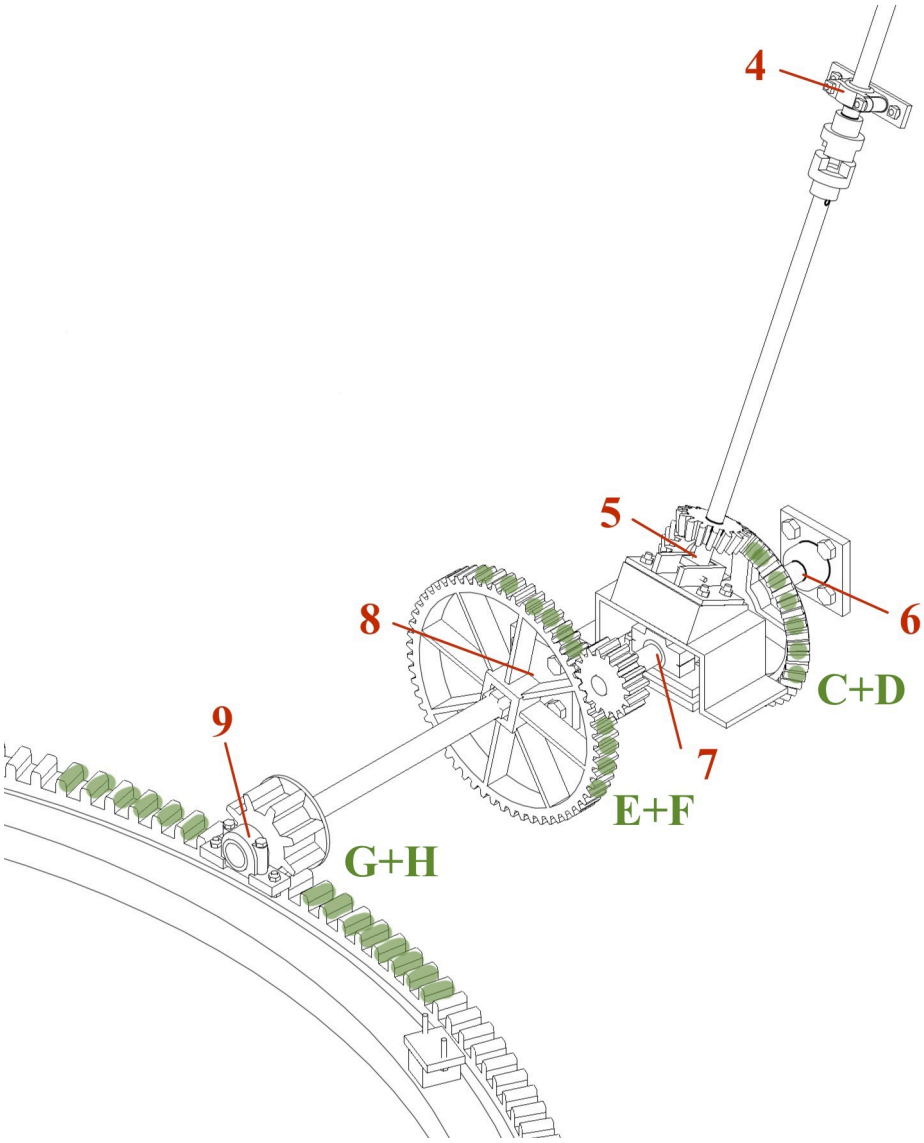
Key:

1 = RH bearing - grease
2 = LH bearing - grease
3 = Upper bearing of down shaft - grease (see page 21)

Meshing teeth of bevel gears A + B (shown in green) require monthly greasing

2.4 Fantail gearing (continued)

DOWN SHAFT, REDUCTION GEARS AND FINAL DRIVE TO CURB



Key:

4 = Bearing above coupling - grease
5 = Bottom bearing of down shaft - **oil**
6 = Outer bearing of intermediate shaft - grease
7 = Inner bearing of intermediate shaft - grease
8 = Outer bearing of final drive shaft - grease
9 = Inner bearing of final drive shaft - grease (see page 21)

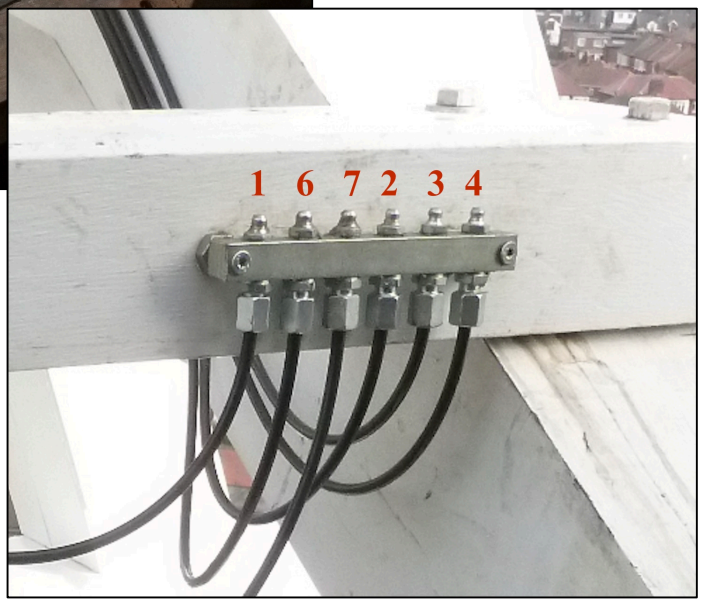
Teeth of bevel gears C + D, Spur gears E + F and rack & pinion G + H require monthly greasing

2.4 Fantail gearing (continued)

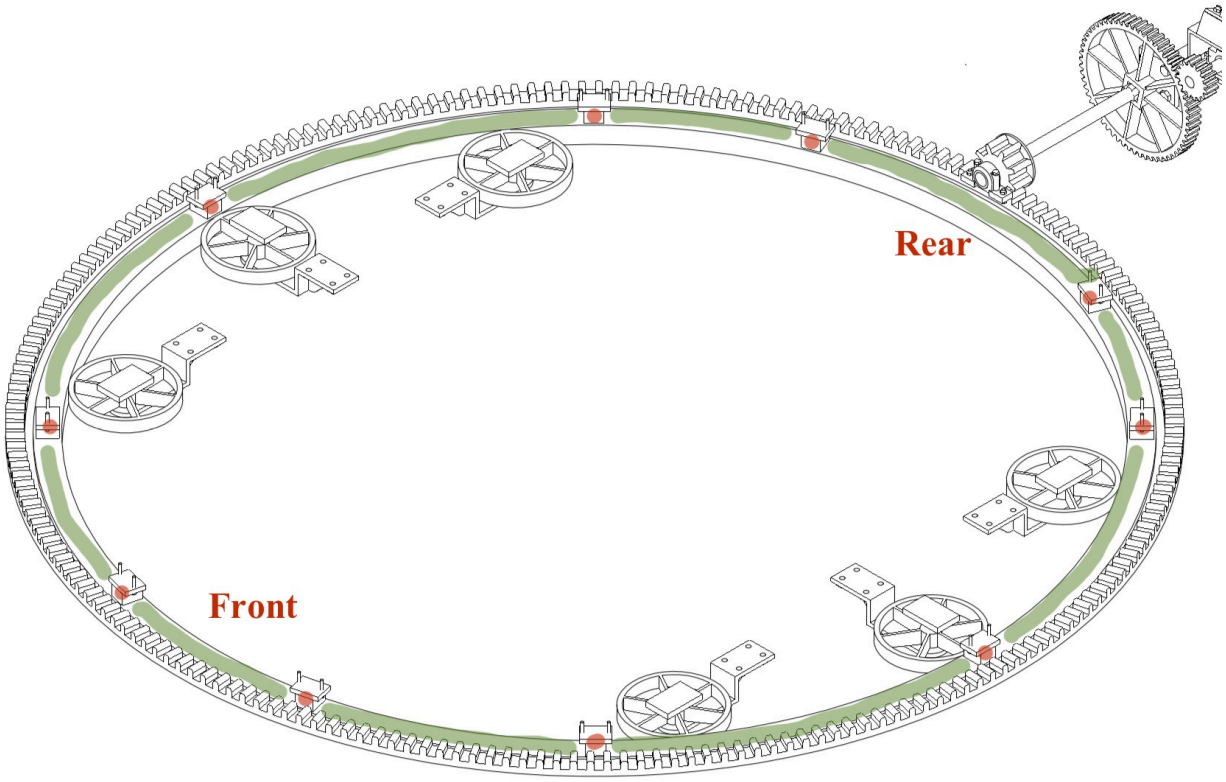
LOCATIONS OF GREASING POINTS FOR BEARINGS OF FANTAIL GEARING

Numbered grease points relate to diagrams on pages 19 & 20.

Bearings require 1 pump of grease gun, monthly.



2.5 Curb track, cap skid blocks and cap centring wheels

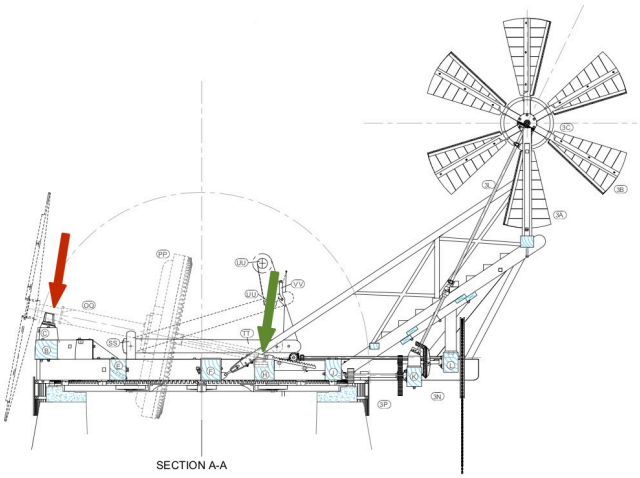


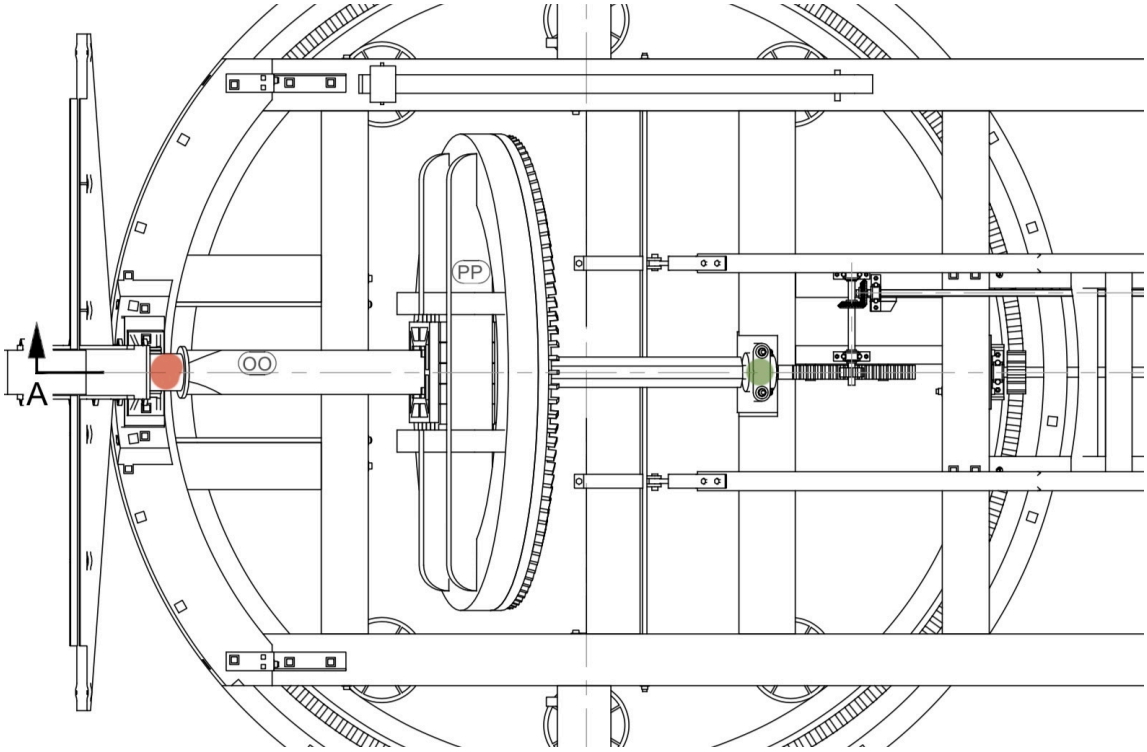
Cap centring wheels do not require lubrication.

Skid block positions shown in red. The two at the front of the cap are mechanical skates.

The upper surface of the curb track, shown in green, requires monthly greasing.

2.6 Neck bearing and tail bearing of windshaft





Key:

Neck bearing, shown in red, requires weekly greasing
Tail bearing, shown in green, requires weekly oiling

Appendix

Recommended lubricants

GREASE

Lithium EP2 multi-purpose high temperature grease – used from installation by Owlsworth IJP millwrights.

OIL

Golden Film bearing oil from Morris Lubricants:

http://www.morrislubricants.co.uk/products/classsteam/bearing-oils-6/golden-film-460-bearing-oil.html

Possible additions

Equipment list - cleaning and maintenance materials/products

Procedures when open to the public, accessing cap

END OF DOCUMENT

BMHC, Draft 2, May 2018

Comments or improvements always welcomed.