# KING'S MILL

## ST PETER'S VALE
## STAMFORD

A Survey

Industrial Archaeology Section
University of the Third Age (Sleaford Branch)
December 2002

EL1 8536 SLI 11826 PRN 37082 Listed. Here is no record for this mill only for an adjacent corn drier. MBT.

# Kings Mill Stamford

The following notes and sketches were made following a visit, on 18th July 2002, to the Mill by members of the Sleaford U3A Industrial Archaeology Group. This was done with the kind permission of Mr and Mrs Theo Peters who have made the Mill their home having sympathetically preserved what remains of the mill workings in a truly beautiful setting.

The history of the mill is not discussed here (although some notes on this were provided by Mr and Mrs Peters and are included as an appendix to this report) The mill, with its two novel tandem wheels, is felt to be important in terms of the evolution of water driven mills. It was only possible during the visit to make cursory notes and to photograph some easily accessible features. This report therefore is not intended to be in any way definitive, clearly a mill of such importance warrants a far more in-depth study.

Many replacements and alterations have been made since the mill was first built although it is almost certain that the layout, two undershot waterwheels on opposite sides of the mill and their associated drives to the four grinding wheels have remained basically unchanged. The north wheel appears to have been replaced towards the end of the mills working life, possibly in the later part of the nineteenth century. It is an interesting lightweight construction utilising simple cast components, quite unlike the conventional water wheels associated with corn mills, but clearly capable of transmitting the required motive power. It is possible that a local engineering works made the parts and research may uncover drawings, patterns and other records that could confirm the date of the replacement. The south wheel and the other mechanisms are of more robust design but do have some unusual features and bear witness to the ingenuity of the millwrights who built and maintained them through the years.

Kings Mill is set at the west end of the Stamford's Town Meadow on ordinance reference point TF026067, and together with its out buildings has been converted into three separate dwelling houses. *See page seven (figure1).* To the south of the mill is a barn, which would have been built later than the main mill and is now used as a community day centre. To the west of the mill is a small millpond fed by a stream, the footpath running alongside being known locally as the Melancholy Walk. The stream, which is man made, takes water from the river Welland, at ordinance reference point TF018062. giving the millpond its head. *See page eight (figure 2).* From the millpond are a number of sluice gates, only one of which remains in use returning water to the river Welland. Originally the river Welland ran either side of the "Town Meadow" but the feed to the north leg is silted up and consequently the main source of water to the river running to the north of "Town Meadow" is water from the millstream, taking the line of what was probably only an overspill stream to the south of the barn when the mill was in use. *See page nine (figure 3).* This water from the millstream is now controlled with a sluice that has had no connection with the mill and is of comparatively recent construction.

The sluice which originally returned water to the river along with the two sluices which fed water to the right and left hand mill wheels are still intact but have been sealed and isolated from the pond. *See pages ten and eleven (photographs 1,2, & 3).* The route of the these three water courses beyond the wheels and sluices pass under the buildings and are not visible and have almost certainly been back filled and lost.

The main mill building, much of which is original and dates back to c1640, is three storey's high with stone walls some 28 inch thick. A schematic drawing showing a section of the mill and the drive from the two mill wheels to the four pairs of grindstones on the second floor is shown on *page twelve* (*figure 4).* Both drives and all four grinding wheels remain in place along with the remains of some secondary drives on the first floor which would have been used for driving hoists and ancillary milling equipment. *See page thirteen and fourteen (photographs 4,5 & 6).* The grindstones are typically 48 inches in diameter and 12 inches deep. The grindstones are a mixture of grit stones and burrstones. One burrstone has marked, on its central bearing the legend "Maker WJT Child Hull and Leeds" and on its four inserts "Millstone Balancer Patentees Clarke Mark - Lane London 1859".

Of the two water wheels, which would have supplied the motive power the south wheel is the oldest, although clearly not the original. Its general construction is shown on *page fifteen (figure 5).* It has thirty 14 inch deep x 42 inch wide paddles which are bolted to internal flanges cast onto four left hand and four right hand identical cast iron segments. These segments are fixed together by "fish plates" making up two 160 inch diameter annular rings. Each ring is connected by twelve steel spokes to two central flanges, which are in turn keyed to the main drive shaft via a secondary flange. *See page sixteen (figure 6)* The paddles themselves finally link the two rings. *See pages seventeen and eighteen (photographs 7,8,9 &10).* The main drive shaft is supported at its extreme end by a half cup bronze adjustable bearing held in a cast iron housing. The housing is mounted on the wall dividing the millrace from the original controlled outlet of water from the millpond. The use of deep keys to facilitate the assembling of the central flanges without removing the drive shaft copies the system adopted on the main mill drive, inside the mill, which is clearly much earlier and was possibly quite novel at the time it was constructed. The main wheel could be assembled and disassembled simply being constructed from segments and individual spokes.

The north wheel, which could have been similar to the south wheel or the original, possibly wooden wheel has been completely replaced with one of a unique design and construction. It is, in comparison to the south wheel and other contemporary mill wheels technologically extremely advanced. It is a light fabricated wheel with modular components. The main drive shaft has been changed to have a central square section On to this square section are keyed, or wedged, two cast square bosses, each with eight radial pockets. Into each of these pockets are bolted eight cast "X" section spokes. The spokes are, in turn, bolted to a light cast iron annulus made up of four identical segments. Unlike the south wheel neither the segment nor the bosses are "handed", making the construction aesthetically out of balance but clearly indicating that the design had been value engineered.

This is also clear in the way the 24 paddles have been produced and fitted. The paddles 48" wide with no sides being simply folded steel plate. Each of the paddles are attached to two light cast bracket which are pegged into the annular ring and fixed with metal wedges Each bracket is braced to the following paddle with a threaded steel rod. *See pages nineteen and twenty (photograph 11,12 & 13.* The design and construction of this wheel shows a clear distinction between the millwright techniques utilised elsewhere in the mill and the engineering techniques being developed and used locally in other industries.

The control of the wheels would have been by the conventional manner of raising or lowering the appropriate sluices. This was done from inside the mill and the mechanism still remains intact for the south wheel. The control for the north wheel has however been turned into a decorative feature at the bottom of the stairwell from the ground floor of the mill to the second floor, which is now the living area of the converted mill. *See page twenty-one (photograph 14).*

Whilst the upper stories of the mill have been changed during the conversion, as have the areas around the millpond and sluices, much of the internal ground floor has remained unaltered. Adjacent to the doorway which gives access from the millpond to the ground floor is a stone block marked WB 1666. As the doorway was modified during the conversion of the mill it would appear that this stone has been incorporated into the wall from elsewhere, but it is most likely that both the stone and the inscription are relevant to the mill. *See page twenty-one (photograph 15).*

The drive mechanisms from both the south wheel and north wheel are similar and are shown on the schematic drawing. See page twenty-two (*figure7).* Both have interesting examples of the skill and ingenuity of the millwrights who installed, maintained and modified the mechanisms over the years. Fixed to the shafts from the mill wheels are bevelled gear wheels. These gear wheels are 60 inches diameter, made from cast iron and have six radial spokes connecting to a central boss. The central boss has a bore of 15 inches diameter. This gear wheel is connected to a flange keyed onto the drive shaft by 4 secondary keys. By knocking out these secondary keys the main drive gear could be "cocked" and removed without having to disturb any other part of the remaining drive other than simply dismantling the bearing at the bottom of the vertical drive shaft. *See page twenty-three (figure 8).* This would have been an important feature when initial installing the drive gearing and in its subsequent maintenance. It would appear that at some recent stage a concrete plinth has replaced a stone plinth on the south wheel, which would have supported the bottom-bearing block, and the builder, failing to recognise the significance, has destroyed its purpose. It is likely therefore that this was done after the mill had ceased to operate, as it is unlikely that a miller or millwright would have approved such a modification. *See page twenty-four (photograph 16 & 17).*

The large bevel gears, which each have 70 teeth drive a smaller bevel gear with 28 teeth 7 inches long with a diametral pitch approximating to 1.5. The small bevel gears are the mounted on the bottom of 14 inch square vertical

shafts. There is a slight difference in the way in which the smaller bevel gears are mounted to the vertical shafts.

Both vertical shafts rise from the ground floor through to a bearing mounted between the first and second floors. It is possible that the shafts at some stage extended through the second floor to the loft, but this has not been ascertained.

On both of the vertical shafts, above the small bevel gear, is a large spur gear, which drive two smaller spur gears. These small spur gears are fitted to the shafts that directly drive one of the four grinding wheels on the first floor. The large spur gears have112 teeth with a diametral pitch of around 1.5. The gear teeth, which are 7 inches deep, are cast on four annular segments. On the south wheel these segments are bolted together on the top and bottom by four 1.5 inch deep hard wood annular segments with the joints offset by 45 degrees. The whole fabrication is then carried on a wooden disc, which itself is made up from four segments and fixed to the vertical shaft. A metal rim holds the disc together, and metal straps connect each of the segments. The construction is also held together by four interlocking wooden struts on top of the gear, which, being bolted through the gear segments and wedged to the vertical drive shaft, act as both a brace and the prime attachment to the vertical shaft. Together with the bottom disc they transmit the whole driving torque from the vertical shaft to the gear train. *See pages twenty-five and twenty-six (photographs 19, 20 & 21).* The method of construction is both elegant and practical. It is economical in the use of material and very efficient. It would have been quite easy to install despite its massive size and is another example of the millwright's art. The large spur on the north drive is of a similar size and construction. *See page twenty-seven (photograph 22 & 23).*

The smaller spur gears are constructed with 26 wooden teeth fitted into a cast housing attached to the shaft driving the individual grinding stones. The mounting and adjusting devices differ showing that they have been modified, possibly following the need to replace worn or broken parts, to what would have been either the latest development or the system that would have been seen most appropriate.

One of the two most necessary features required in the mechanism is the facility to easily disconnect any one of the drives to a grinding stones whilst allowing the remaining stones to remain connected and to continue to operate. This would of course not be done whilst the mill wheel was turning but would have needed to be done easily and safely.

The conventional method of disengaging the grinding wheel drive is to remove the bottom bearing of the shaft driving the stone and simply swing it and the small gear out of mesh. This is the method used to disconnect the drive to the left hand stone driven from the north wheel. It would have been an awkward and time-consuming task that would have necessitated the shaft being lashed or propped into a neutral position. Failure to do this could have allowed the gear to accidentally fall back in to mesh, which could have had serious consequences. It was probably the method original employed for all four wheels. At some stage the drive to the other three stones were modified so

that disengagement could be more simply effected and with complete safety. The method adopted was to allow the small gear to slide up the drive shaft. A lifting, or jacking device was added so that by turning a handle on a screwed rod fixed to the cross beam below the bottom bearing the small gear would be pushed upwards until it was completely out of mesh. *See page twenty-eight (figure 9) also pages twenty-nine and thirty (photographs 24,25 & 26).* The small gear a recessed and slotted cast iron carrier boss with wooden teeth driven into the slots. The teeth extend through the slots into the recess so they can be knocked out easily should they need to be replaced. This has necessitated the carrier boss to be of a somewhat complex design. As the small gear on the unmodified system is of the same type it can be assumed that the design using a complicated housing and wooden teeth predated the modification. As these gears were retained when they could so easily have been replaced with a simple solid cast gear during the modification it can be presumed that spur gears with replaceable wooden teeth were preferred because they would have causing less wear on the large driving gear.

The second essential feature would be the need to adjust the gap between the rotating top stone and the lower stationary stone. This would need to be done whilst the gears were engaged and the wheel turning, the size of the gap determining how finely the grain was ground. The method of adjusting therefore needed to be simple, easy to control and accurate. If the top wheel were allowed to drop on to the bottom wheel it could spark which would be catastrophic in a mill with dust that could ignite causing an explosion or fire.

The method of adjustment is different to all four stones, just as the method of disengaging the spur gears had at some stage been modified so had the methods of adjustment.

It is likely that the right hand stone driven from the south wheel has the oldest and perhaps original method. The bottom bearing to the shaft carrying and driving the stone is mounted on a wooden 10inch x 4inch cross beam, which is pivoted at the back on a cast bracket fixed onto one of a pair of upright 11.5inch x 8.5inch wooden beams which also act as supports for the upper floors. The front end of the crossbeam passes through a slot in the second upright beam. The cross beam is attached to the upright beam by a metal carrier and screwed rod. By turning a nut on the screwed rod the crossbeam is move up and down, raising or lowering the grindstone. *See page thirty-one (figure 10) along with pages thirty-two and thirty-three (photographs 27 &28).* The movement would be relatively small so that the large and small gears would remain fully in mesh but there would be sufficient "backlash" in the gears to accept the small amount of misalignment generated.

On the drive to the left hand stone of this pair a fixed cast iron strut has replaced the wooden crossbeam. *See page thirty three (photograph 29).* This cast iron strut is fixed rigidly between another pair of upright wooden beams with the bottom bearing attached to an integral pivoting arm. This is similar to the right hand drive from the north wheel. Again a cast iron strut with integral pivot arm has replaced a wooden crossbeam. *See page thirty-four (photograph 30).* By moving a handle on the strut the pivoting arm causes the bottom bearing to rise or lower and in turn raises or lowers the grindstone.

This is a far more sophisticated method of adjustment than the pivoted beam method and probably an adaptation or development of the method used on the wheel driving the left hand stone driven from the north wheel. Here the wooden crossbeam has been retained but the bottom bearing mounted on a simpler pivoting arm adjusted by a screwed rod. *See page thirty-four (photograph 31).*

It can be seen from the standard of millwrighting and the progression in the way new ideas were incorporated when making replacements or improvements that Kings Mill was probably the most important of the mills in the Stamford area. It is hoped that the current state of preservation is maintained and its importance recognised so that that at some stage more detailed research and recording can be undertaken.

**David Raines 2003.**

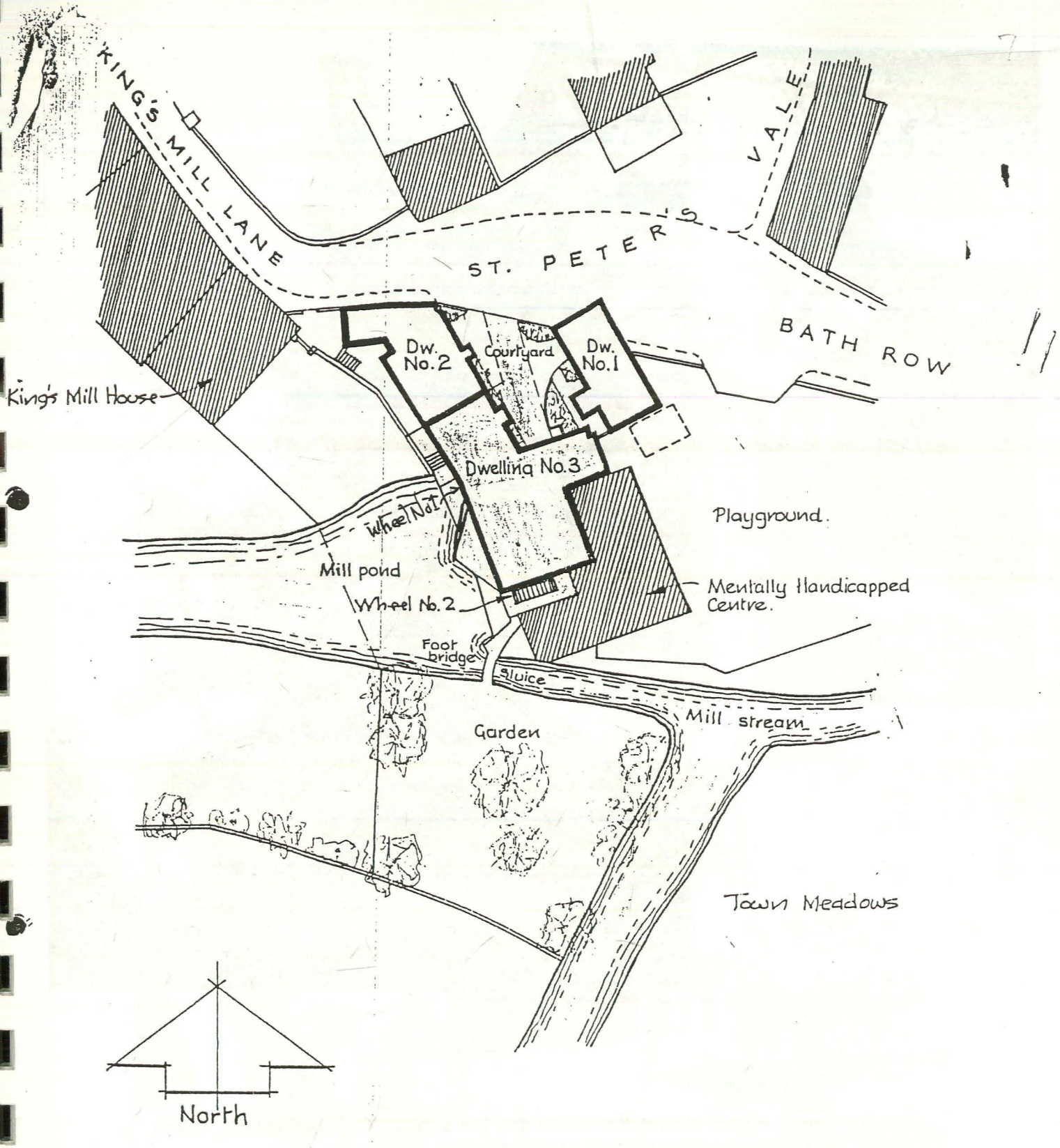
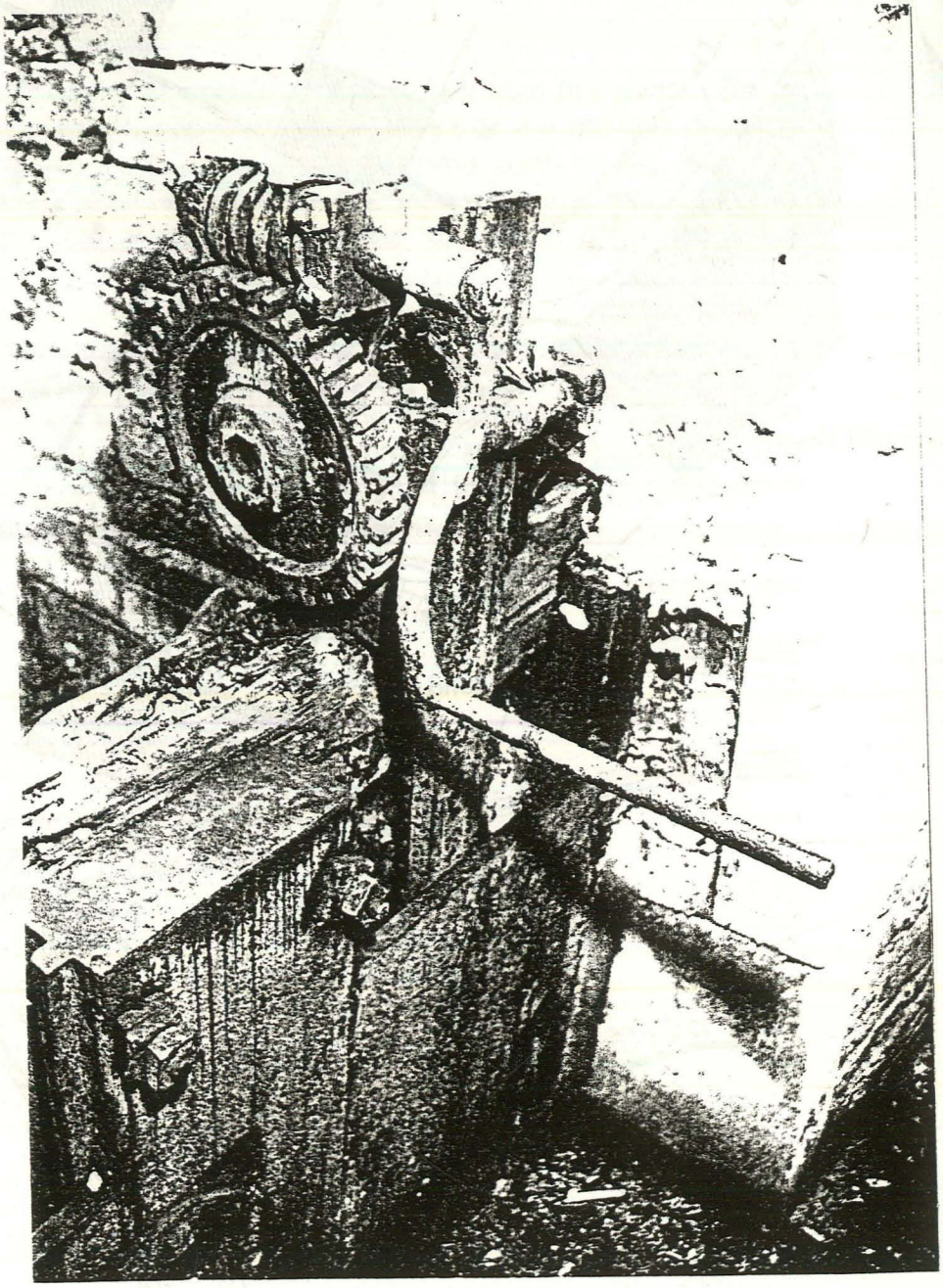



**Figure 1**

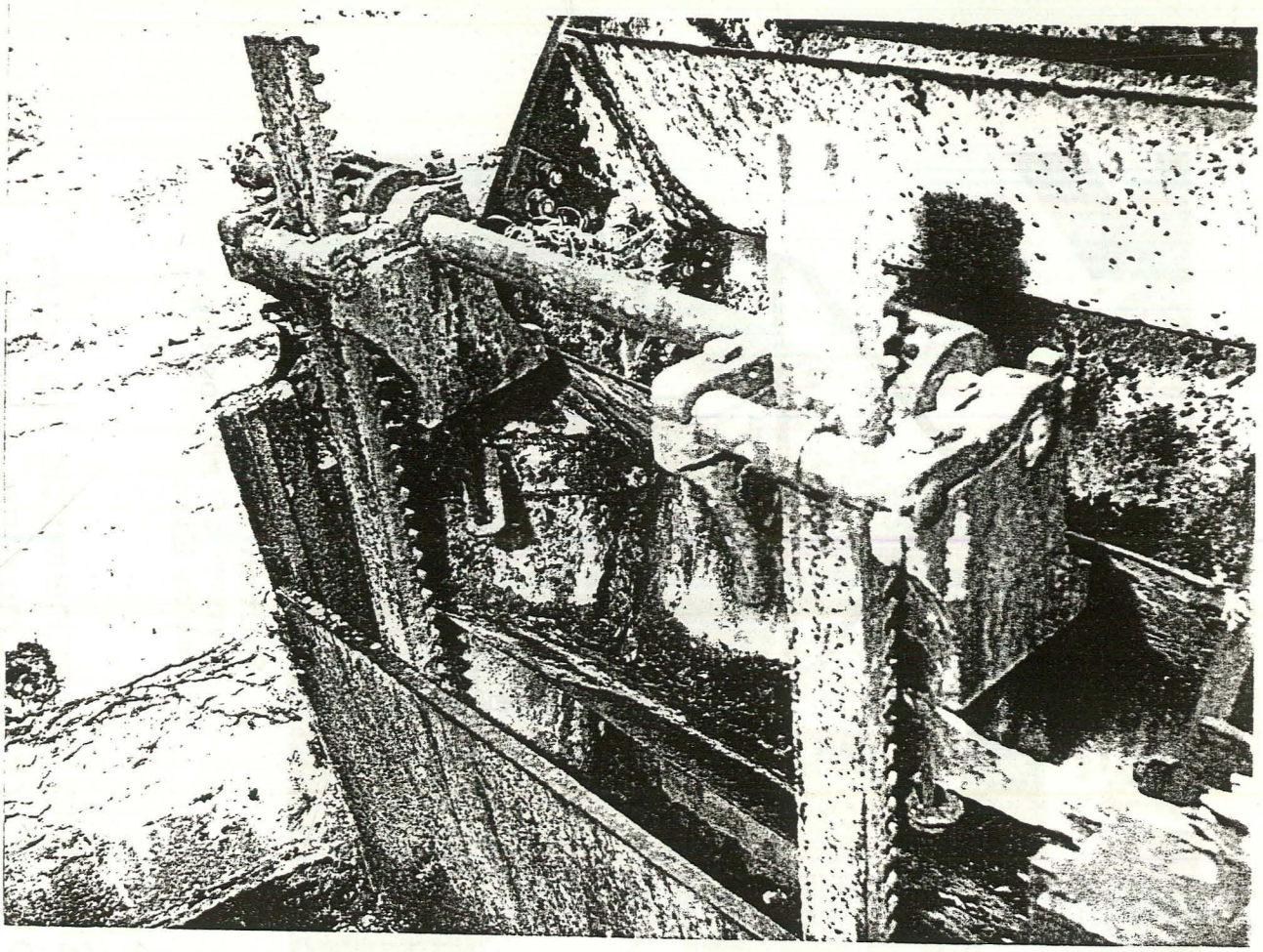
**Site map of Kings Mill**



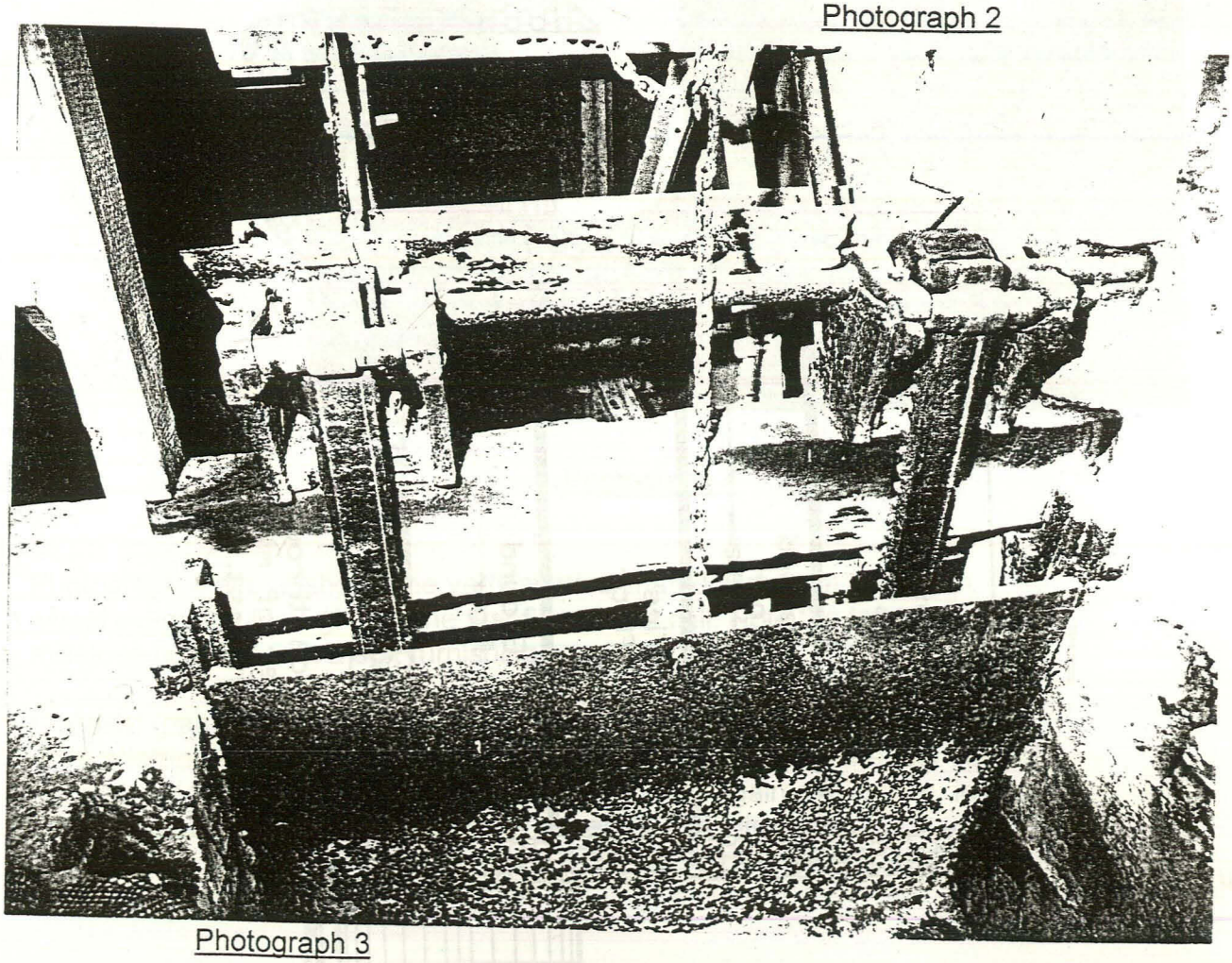
Photograph 1

Photograph 1 above shows the sluice and the sluice lifting mechanism, which would have controlled the outflow of the millpond, back to the river.

Photographs 2 & 3 overleaf (page eleven) show the sluice and sluice raising mechanisms to the south mill wheel and north mill wheel respectively. In both cases the shaft that is turned to raise and lower the sluice to start or stop the mill wheel can be seen passing through the wall. All control of both wheels therefore was from inside of the mill.



Photograph 2



Photograph 3

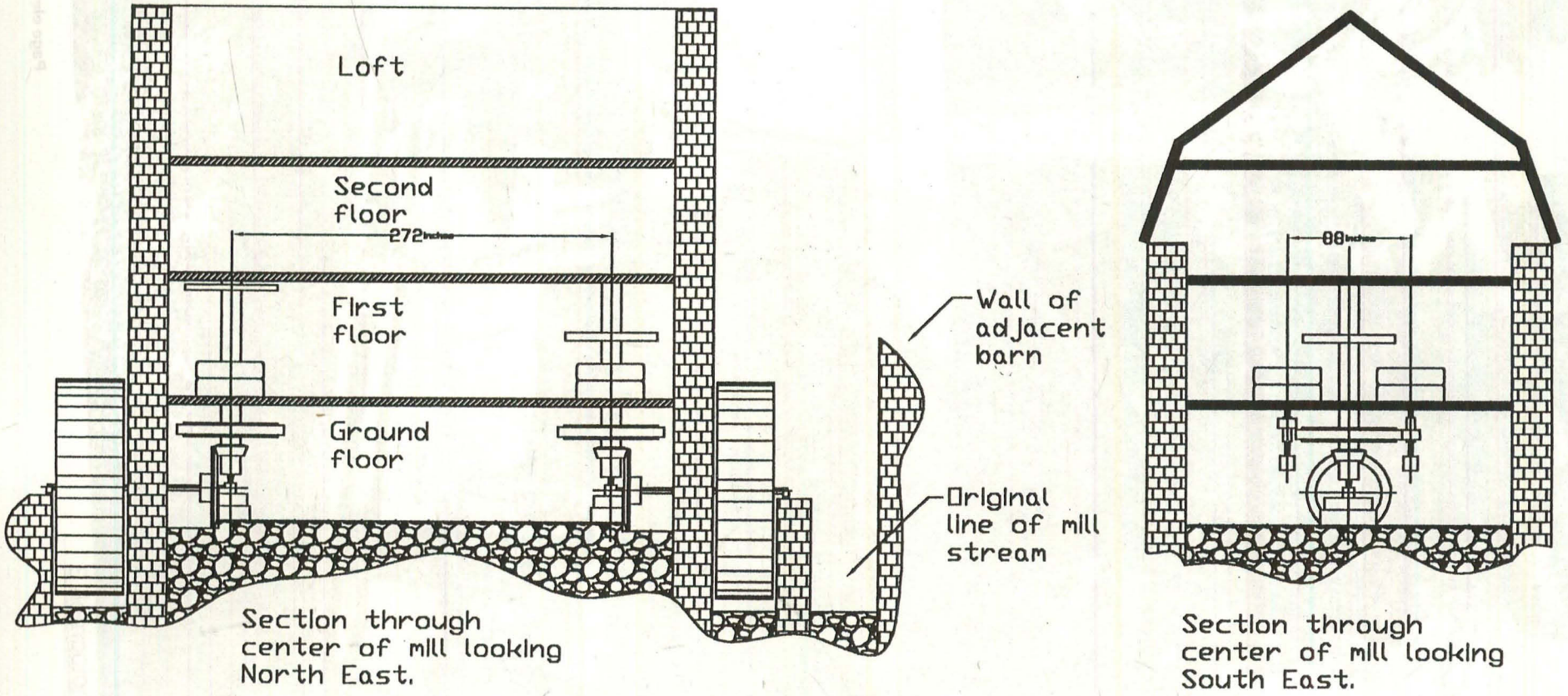
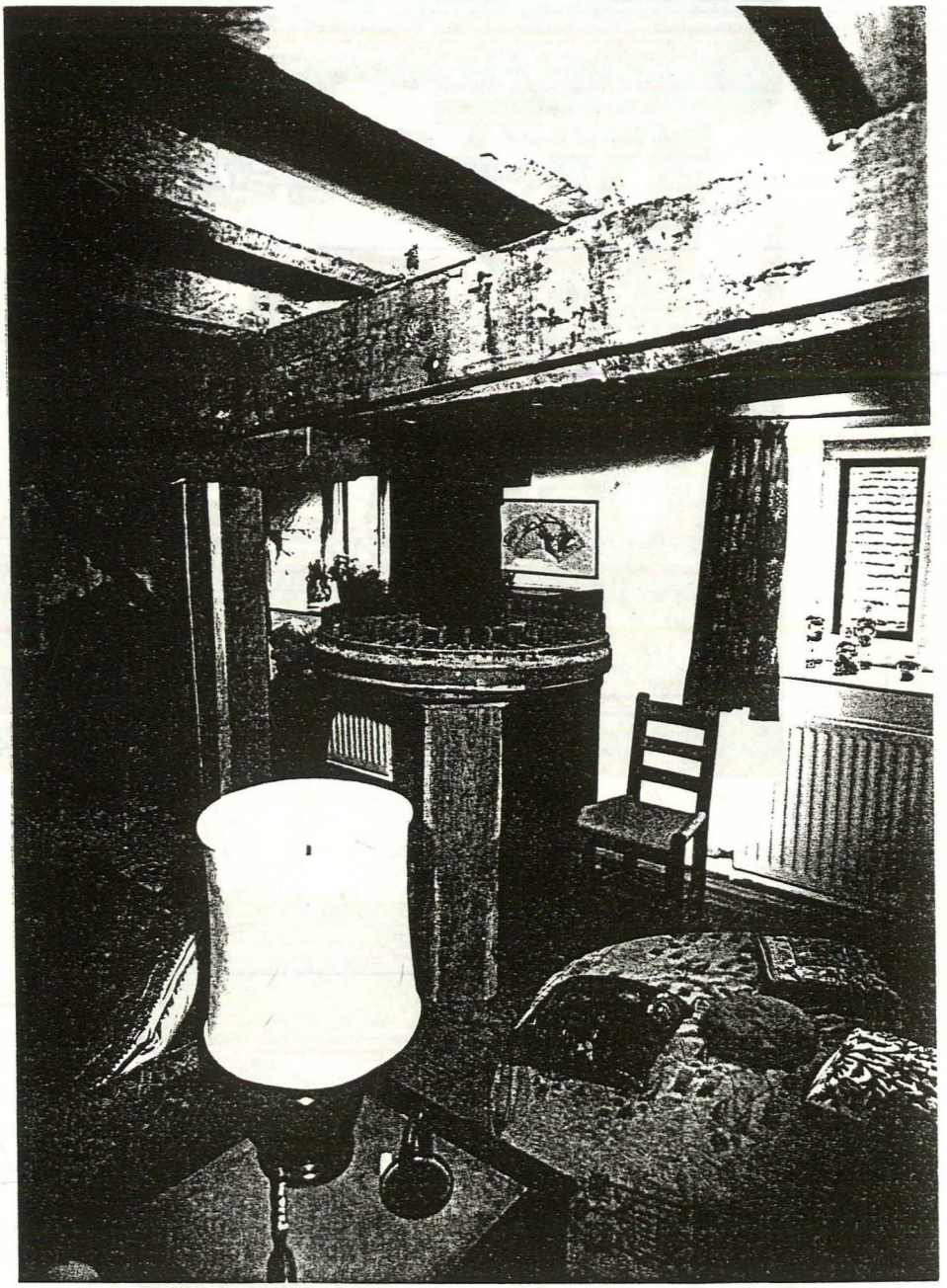



Fig 4
Showing a schematic layout of drive mechanism.

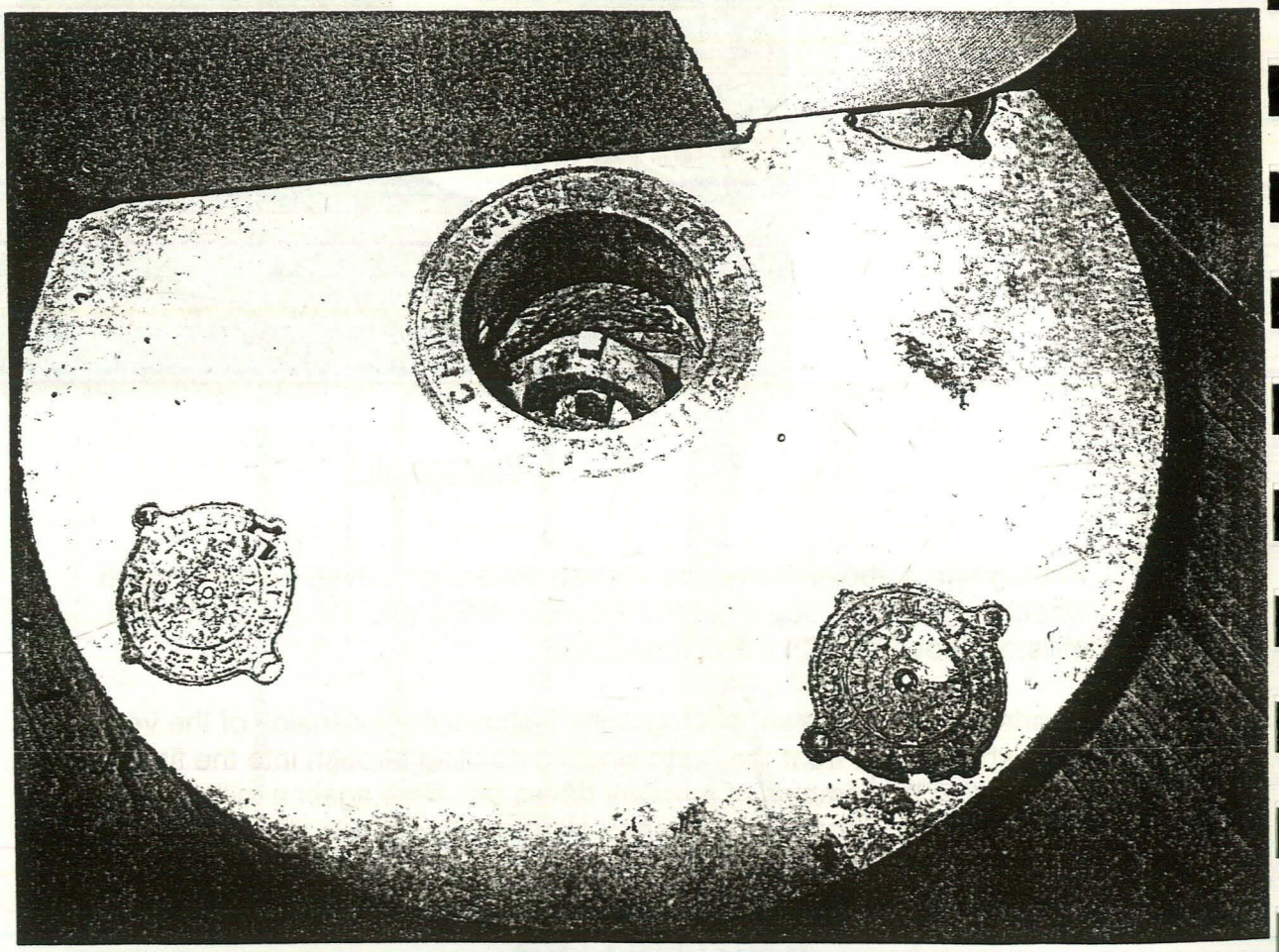


Photograph 4

Photograph 4 above shows the vertical drive shaft driven from the south wheel extending through into the first floor of the mill. Note the left hand millstone covered with a soft furnishing.

Overleaf (page fourteen) photographs 5 shows the extension of the vertical drive shaft driven from the north wheel extending through into the first floor of the mill and the remains of auxiliary drives etc. Note again a millstone, in this case exposed. Photograph 6 shows a closer view of this stone.

Photograph 5



Photograph 6

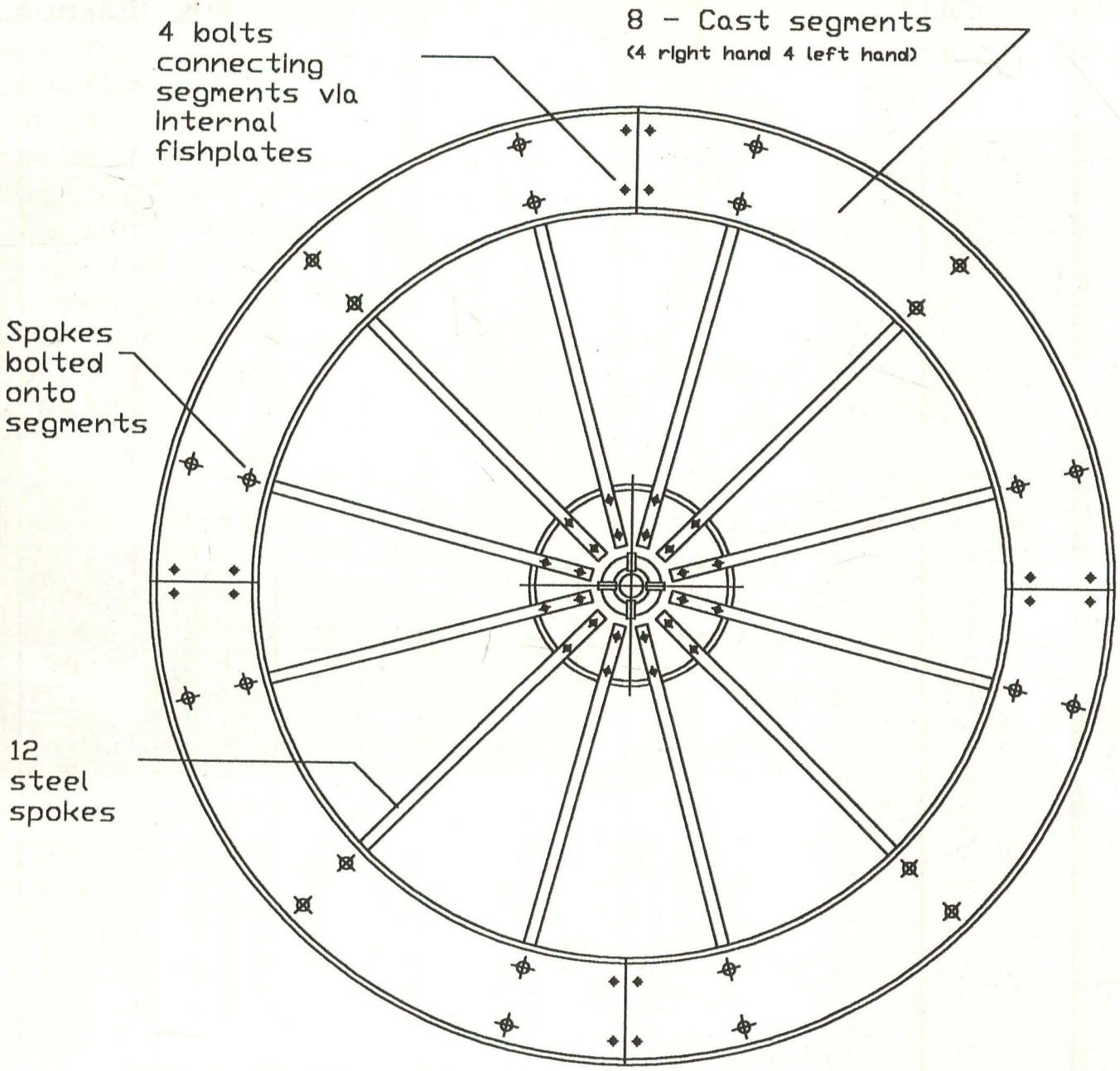



Fig 5
Showing general construction of

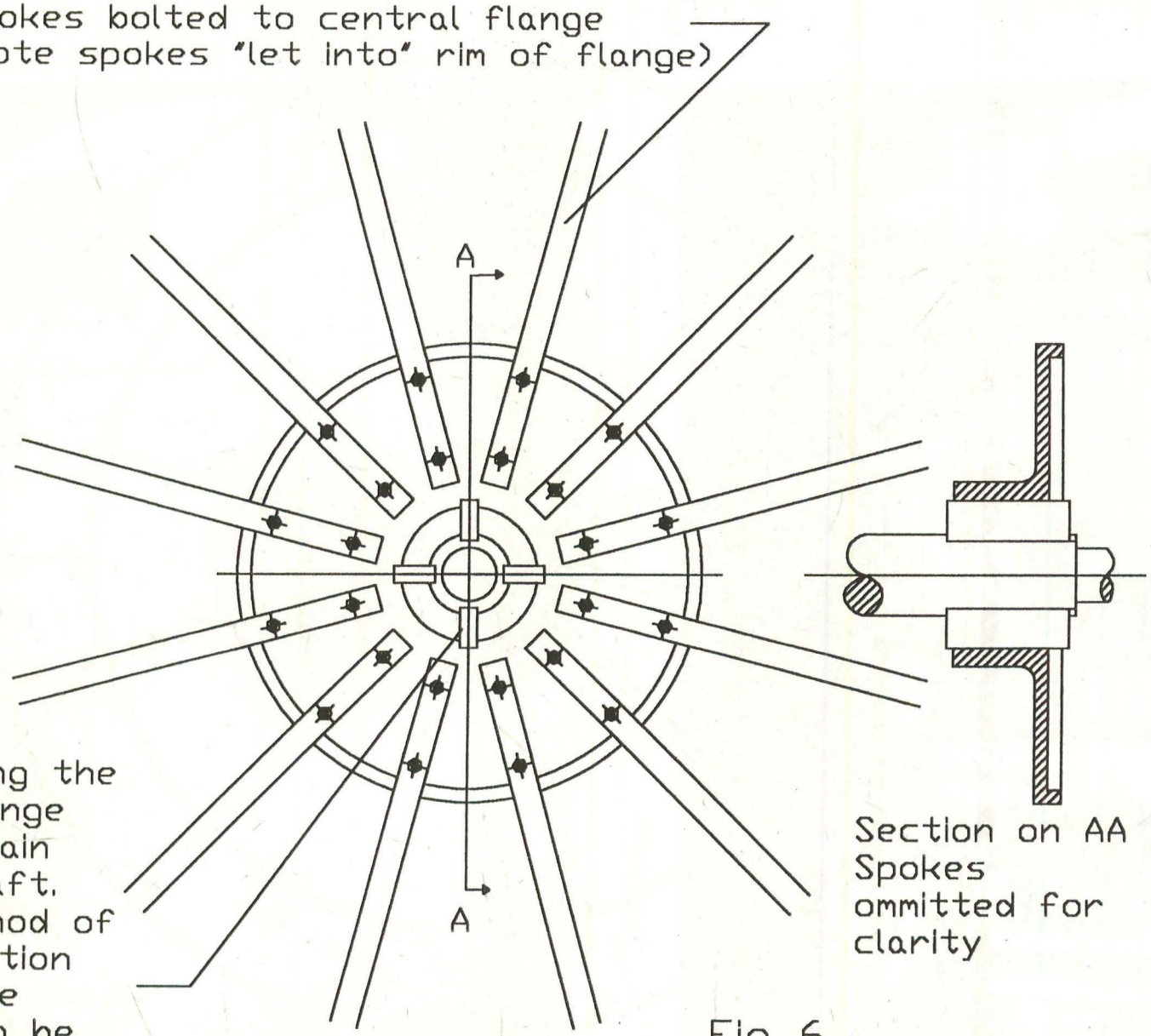
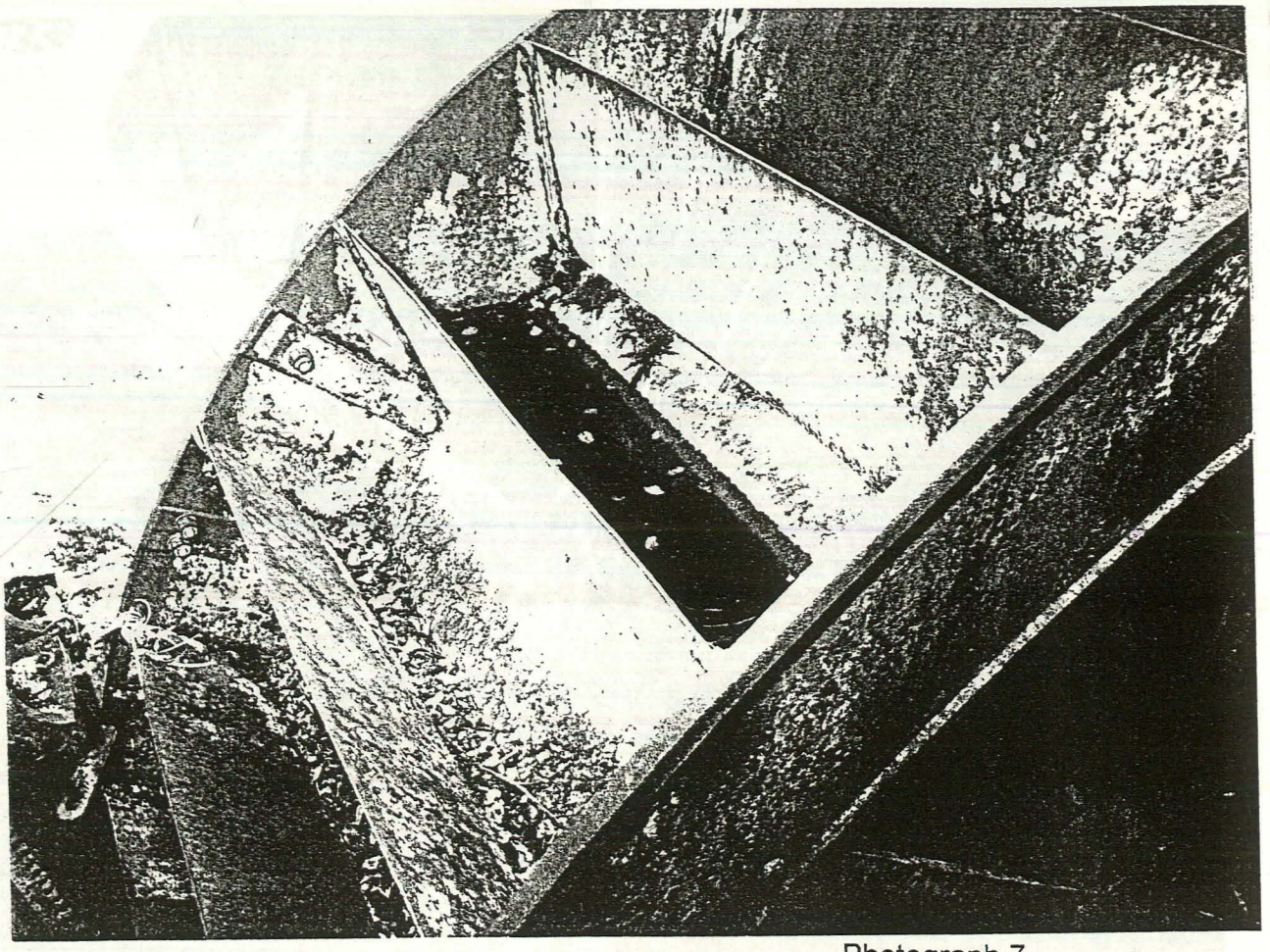
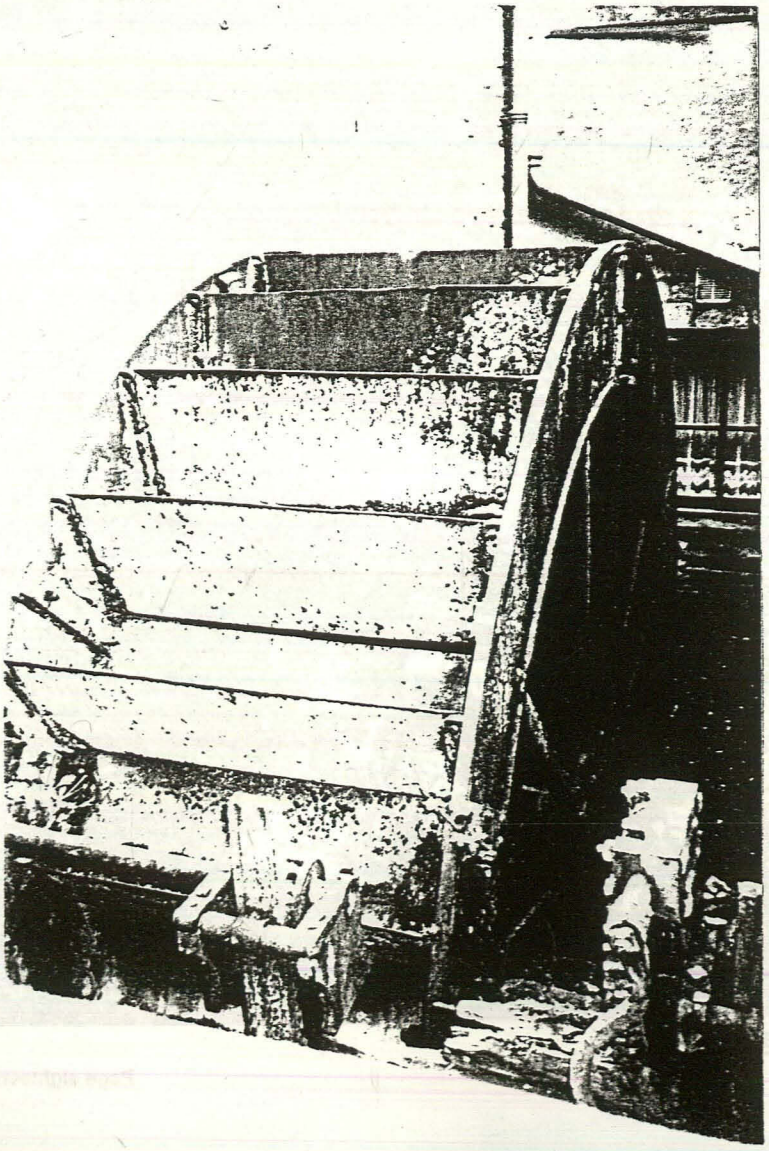



Fig 6
Showing detail of flange keyed to



Photograph 7

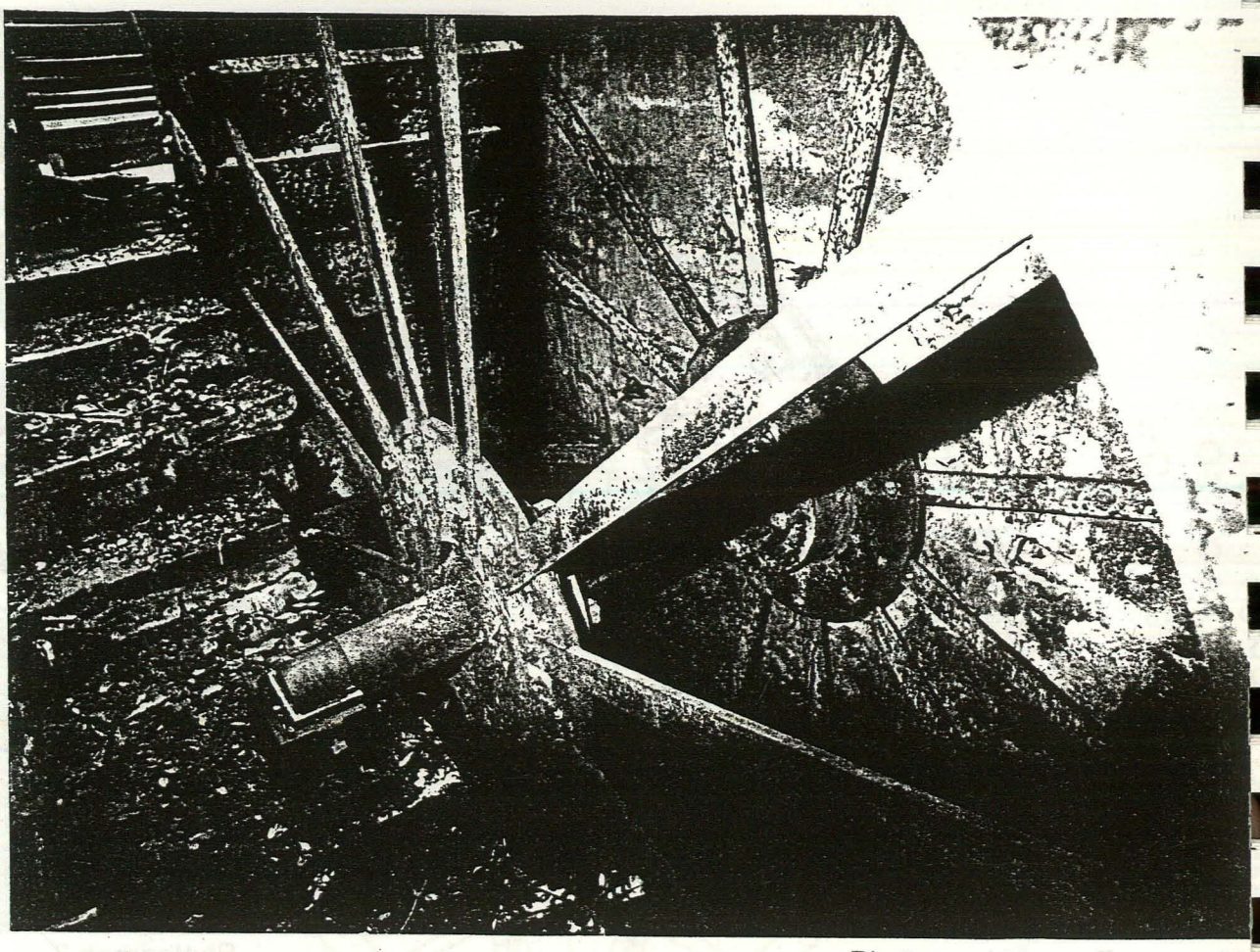


Photograph 7 above shows a detail of the south millwheel. Note the lugs on the annular ring carrying the buckets, the end of one of the spokes and the fishplate joining two segments of the annular ring.

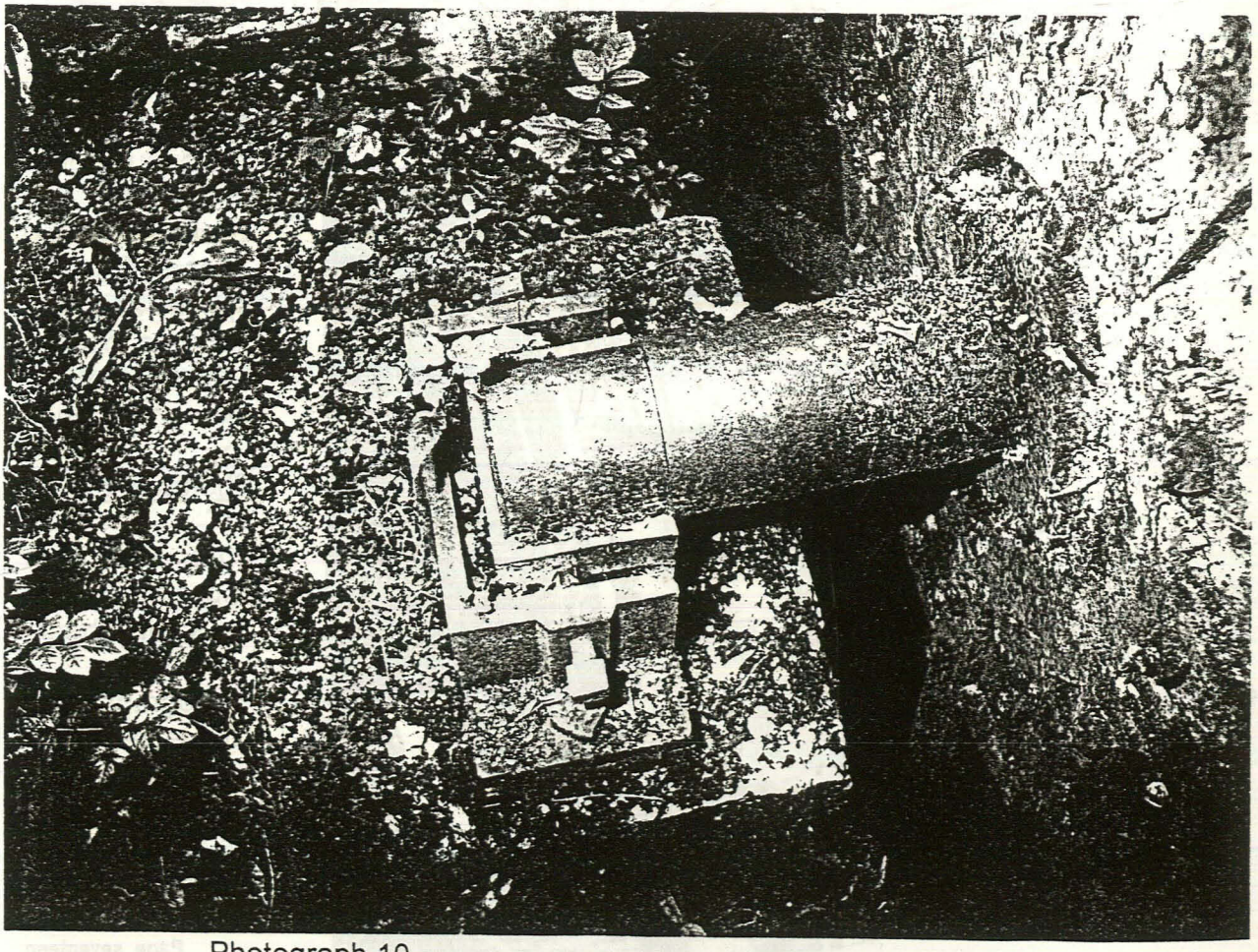
Photograph 8

Photograph 8 opposite shows the south wheel.

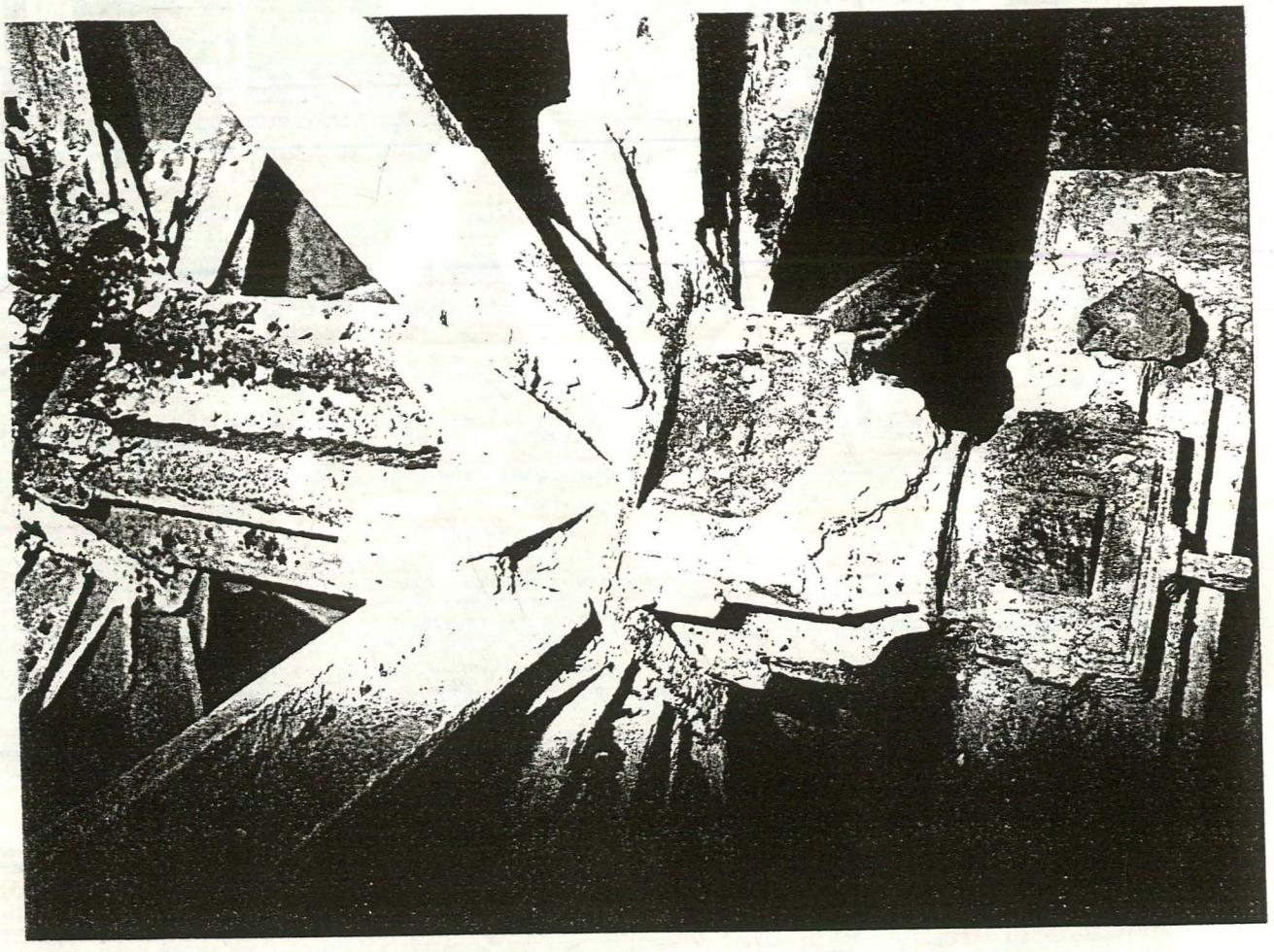
Photograph 9 & 10 overleaf (page eighteen) show details of the drive shaft of the south wheel.



Photograph 9



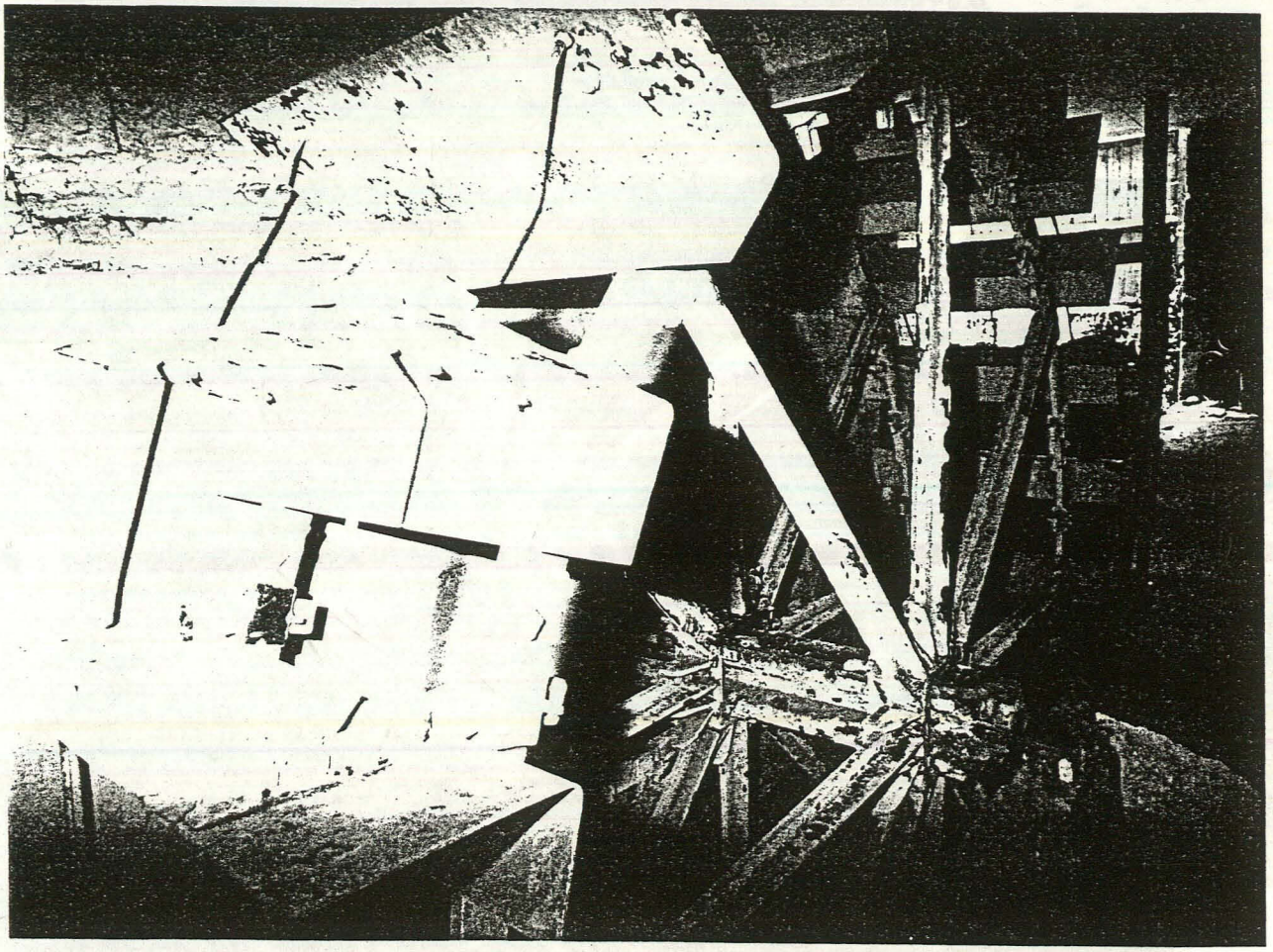
Photograph 10



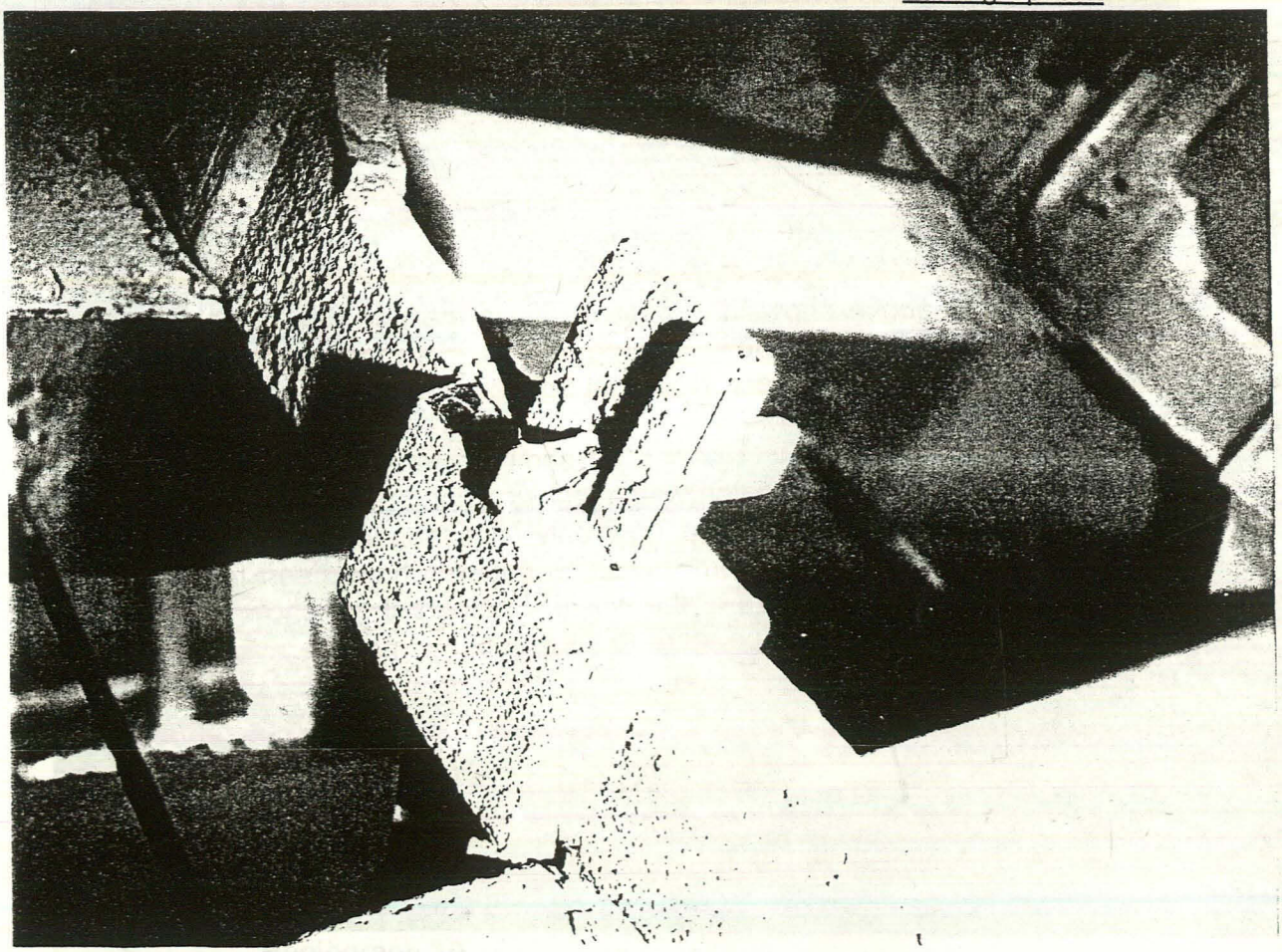
Photograph 11

Photograph 11 above shows the drive shaft on the north millwheel that has been modified to incorporate a square spline. It also shows the two cast bosses with their eight pockets. Note that both bosses are the same hand.

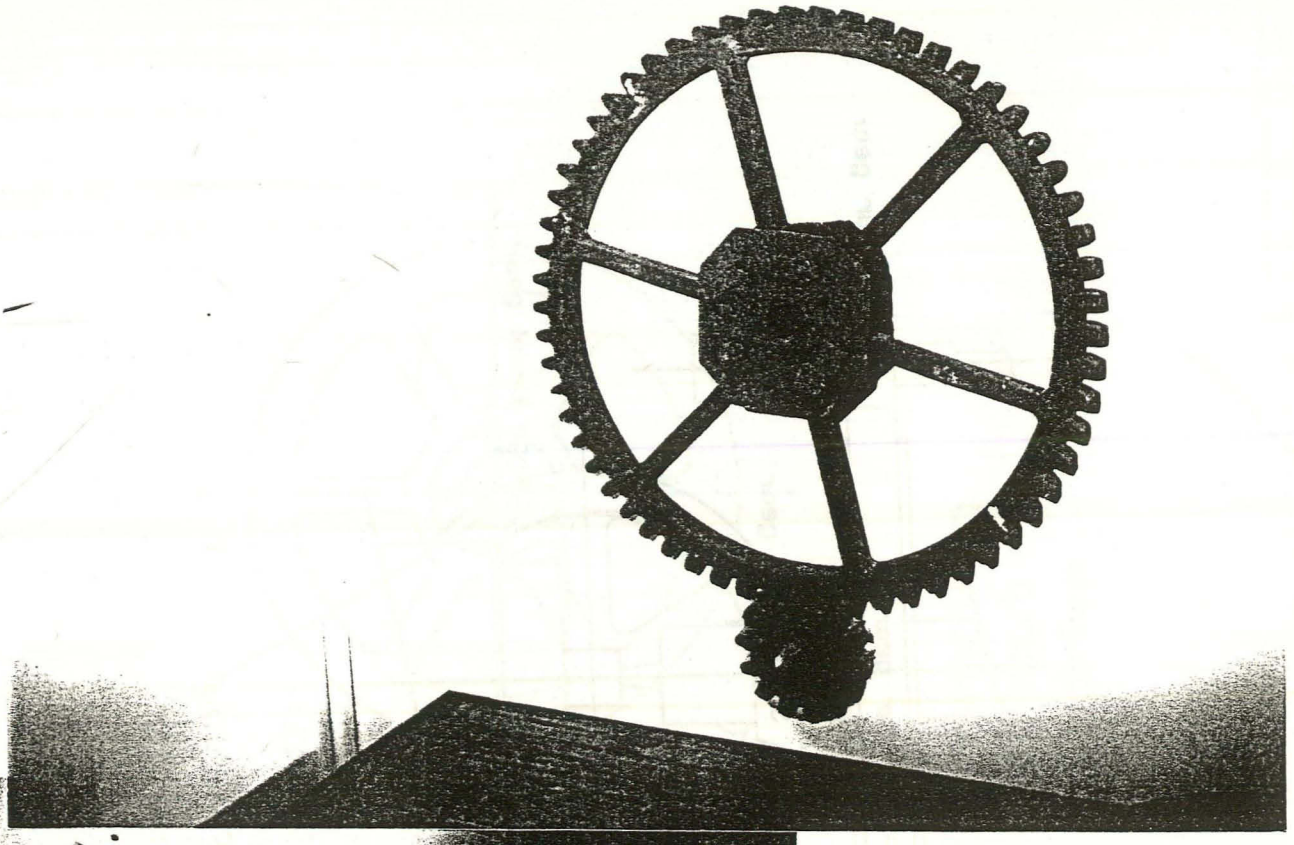
Overleaf (page twenty) photographs 12 shows a general view of the north millwheel. Note the generally lightweight construction both of the wheel and of the individual paddles. Note also how only "one handed" component have been used so that castings from the same patterns have been used on the right hand and left hand sides of the wheel. Photograph 13 shows a detail of how the buckets have been "pegged" to the wheel.



Photograph 12



Photograph 13



Photograph 14

Photograph 14 above shows the gear train for Lifting the sluice to the north millrace. The lower gear is fitted to the end of the shaft Shown in Photograph 3 (page eleven)

Photograph 15

Photograph 15, left, shows the inscription on a stone built into the modified entrance door to the ground floor of the mill.

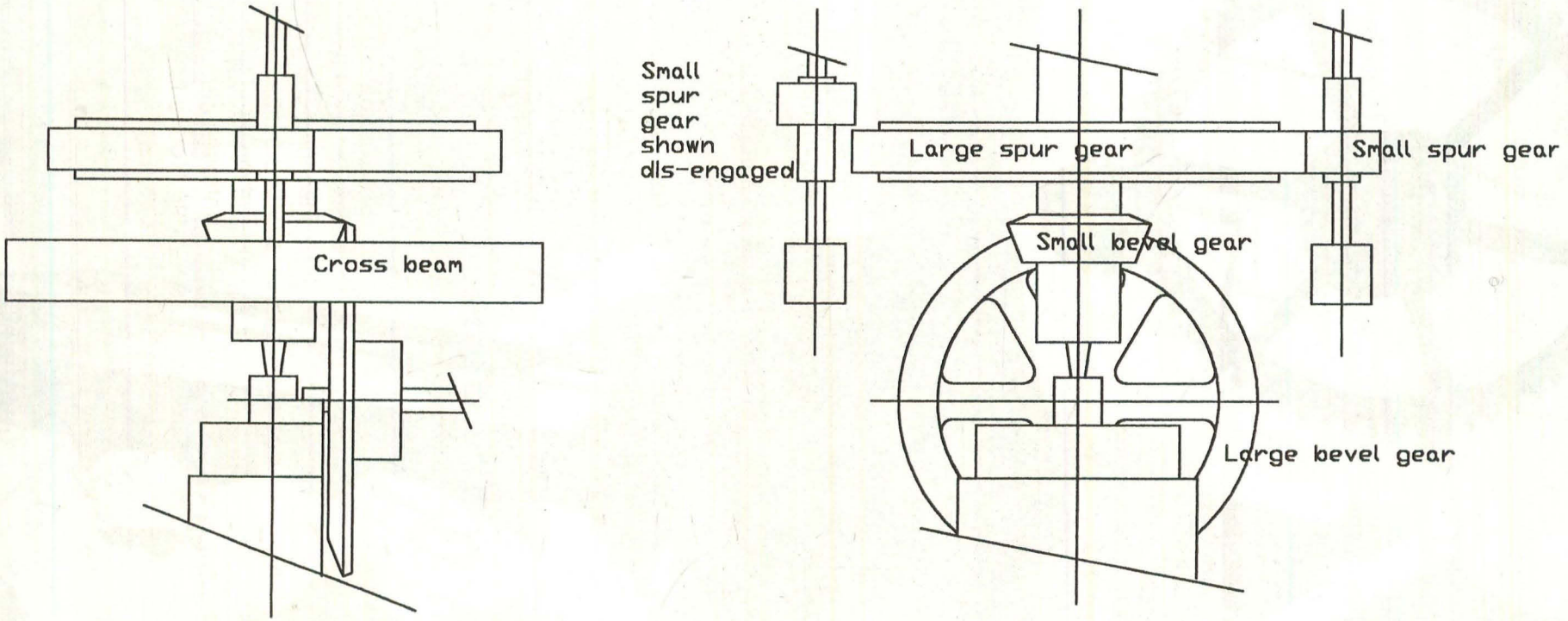



Fig 7
Showing a schematic layout of drive mechanism on ground floor.

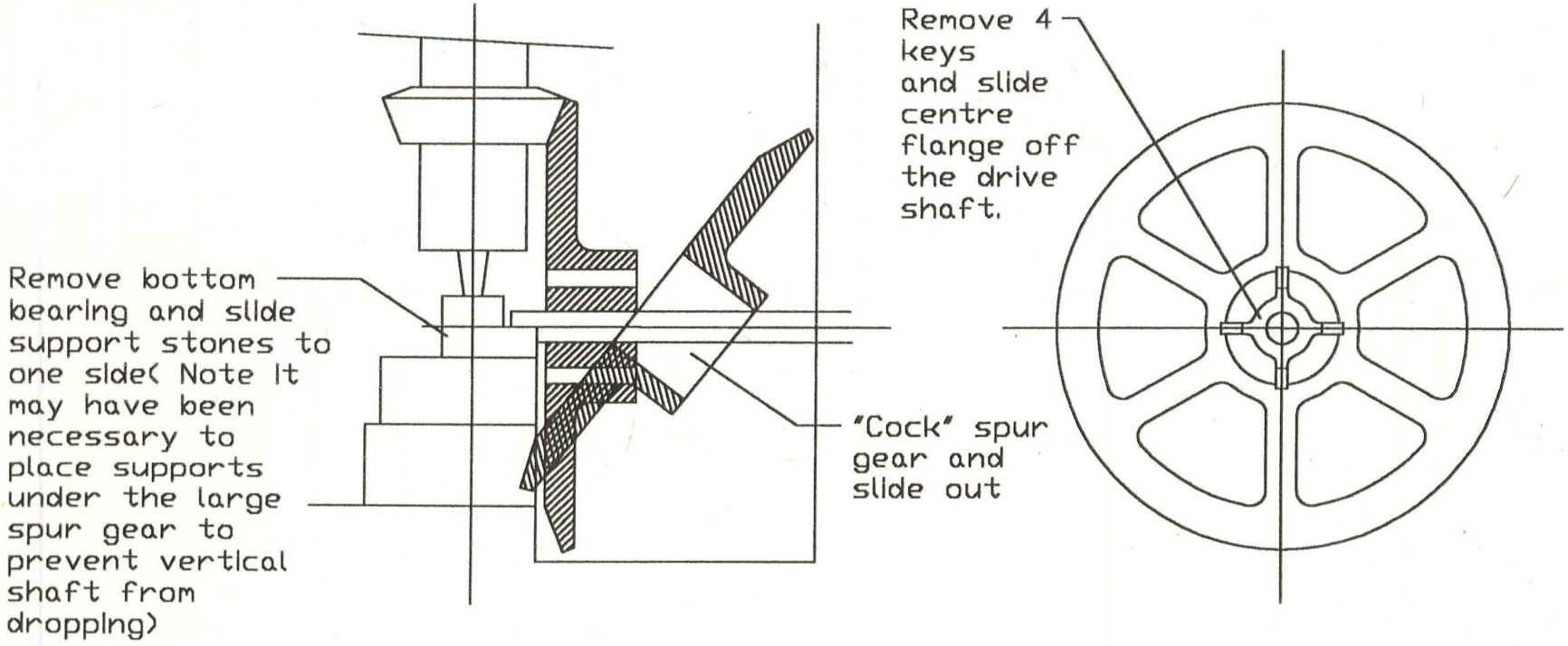
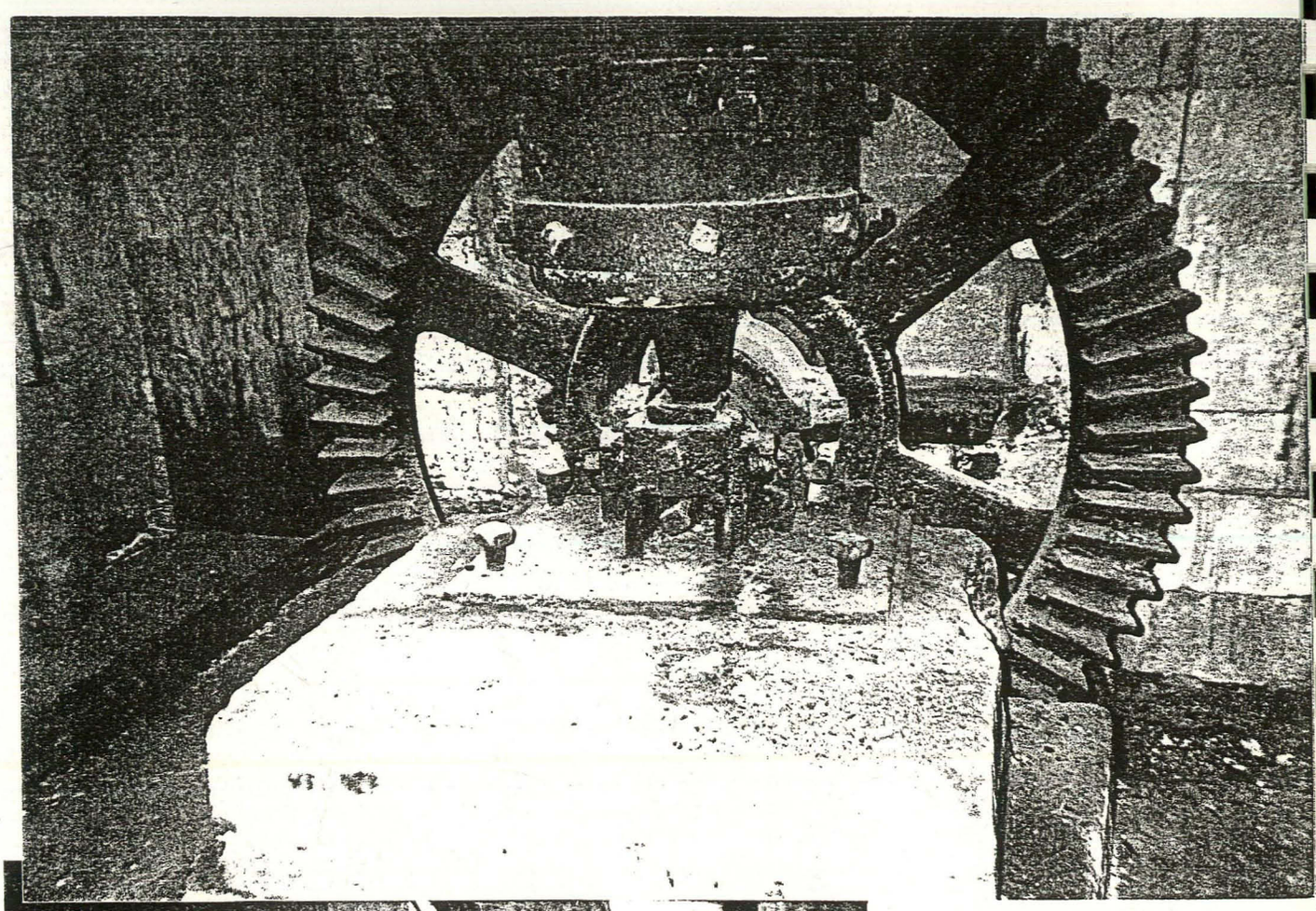
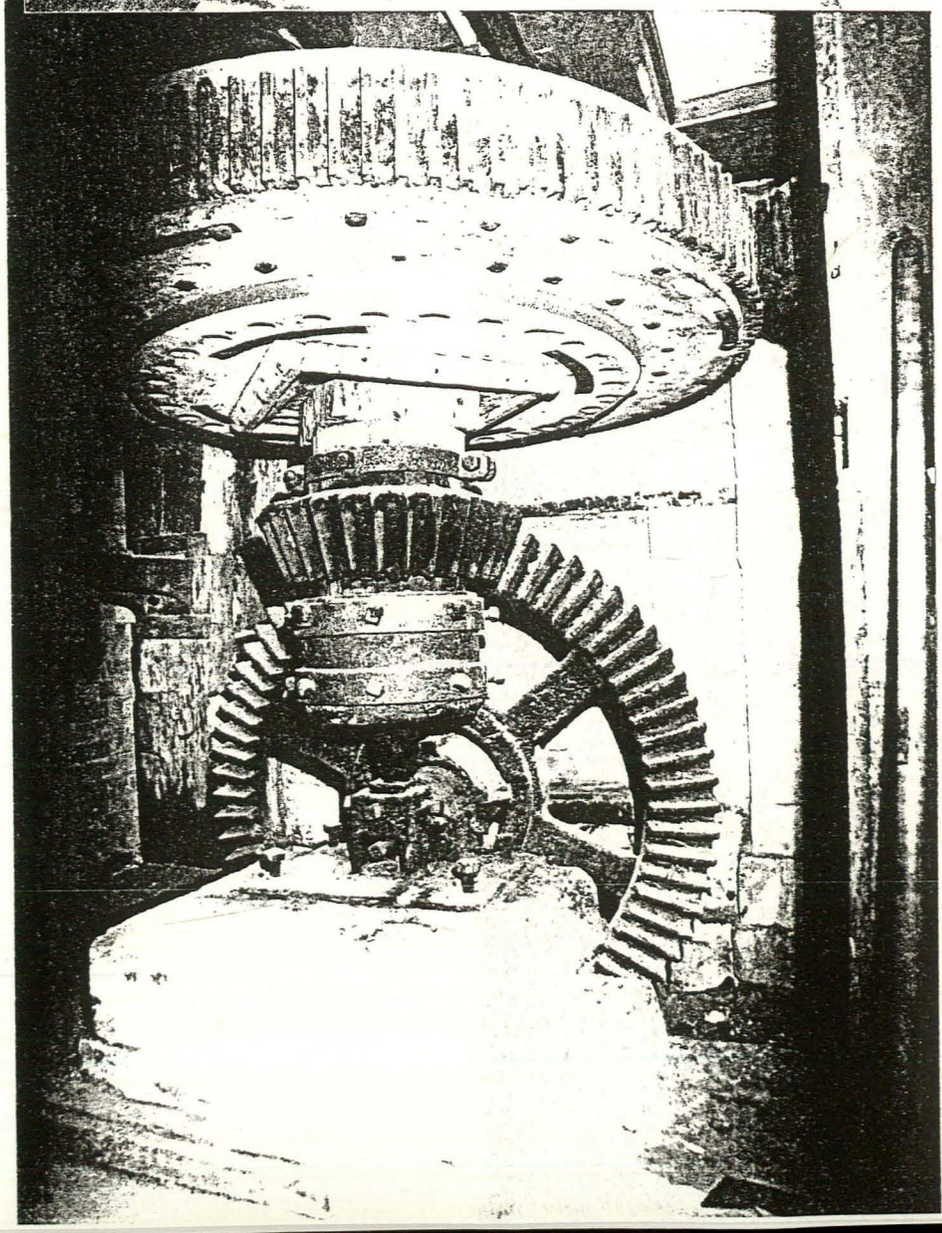



Fig 8
Showing method of removing large bevel gear without dismantling complete drive

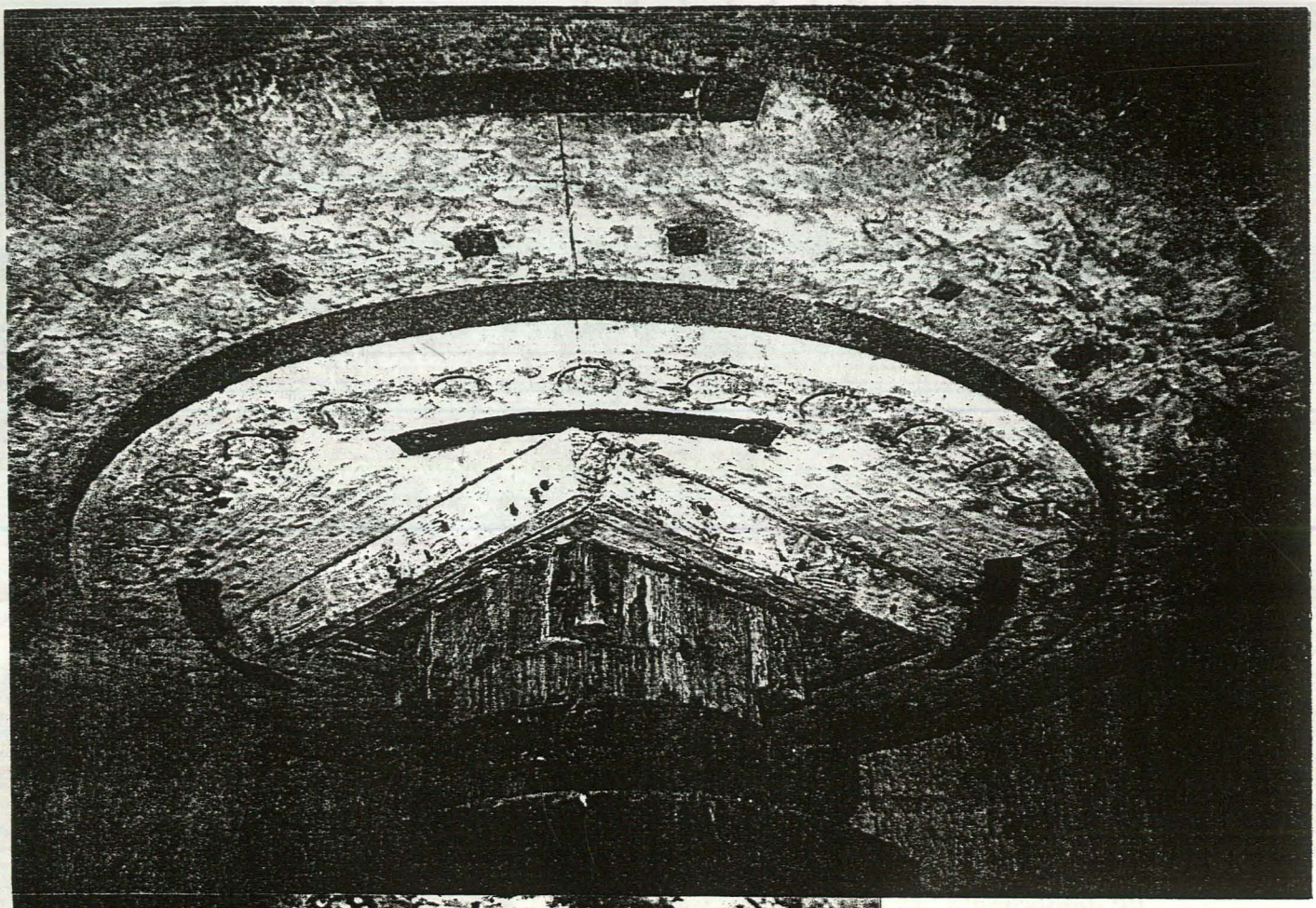




Photograph 16

Photograph 16 and photograph 17 left, show the main drive from the south millwheel. Note the large bore of the large bevel gear, the flange on the drive shaft and the secondary keys. Note also the concrete plinth supporting the bottom bearing block stone

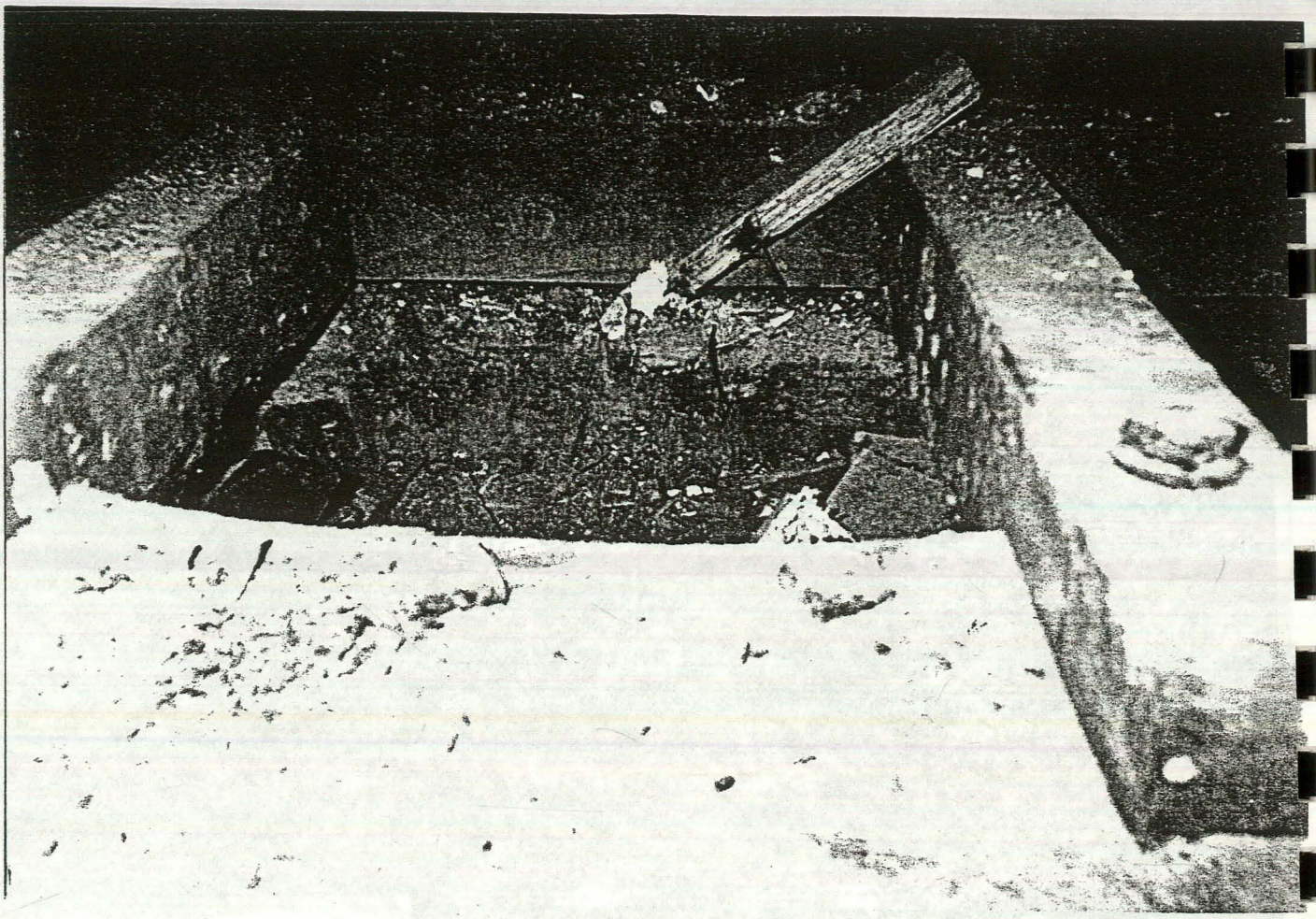
Photograph 17.



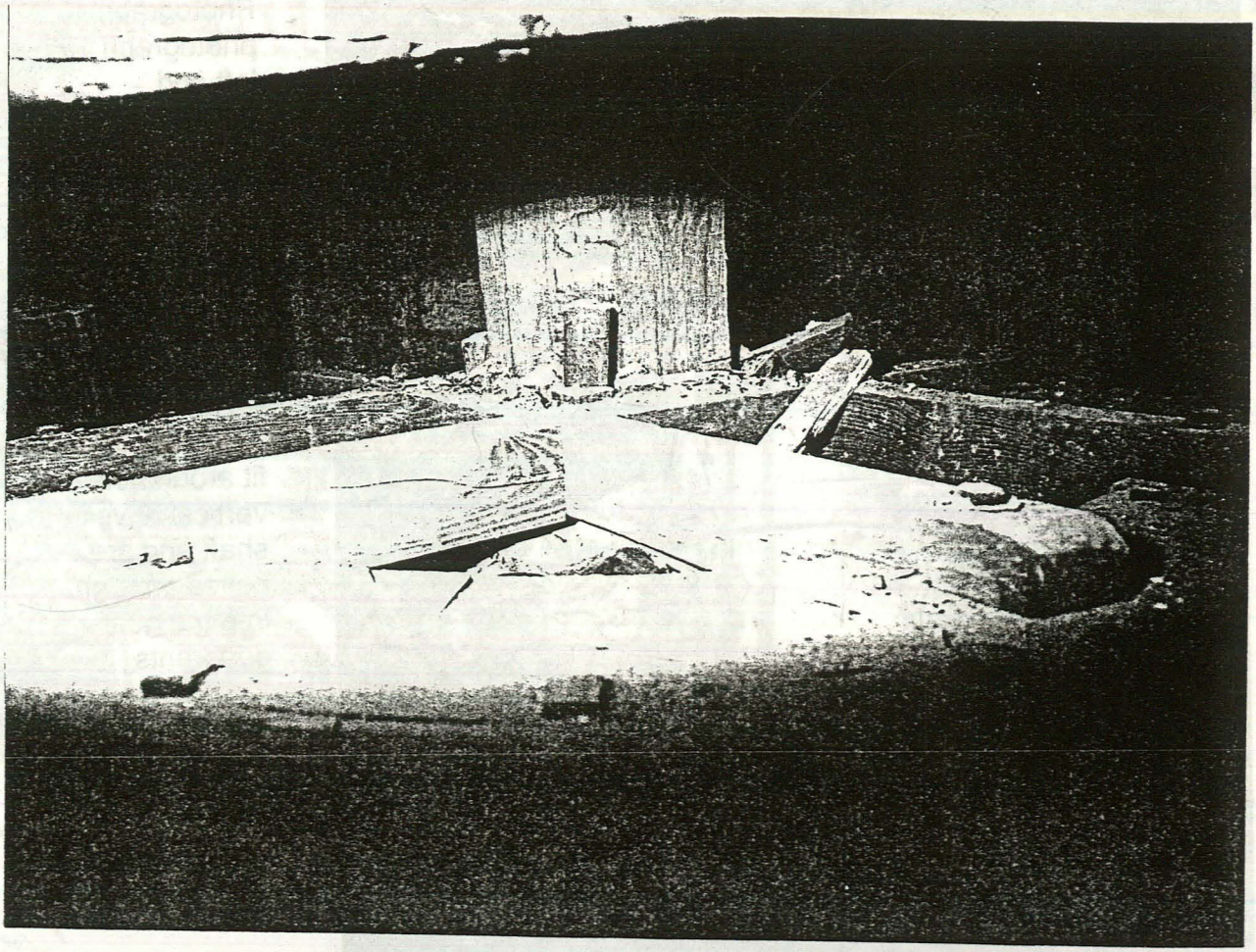
Photograph 18

Photograph 18, photograph 19 left and photographs 20 & 21 overleaf (page twenty-six), show the construction of the large spur gear. Note on photographs 20 & 21 the way the struts are cut to fit around the vertical drive shaft and are bolted through into the gear quadrants

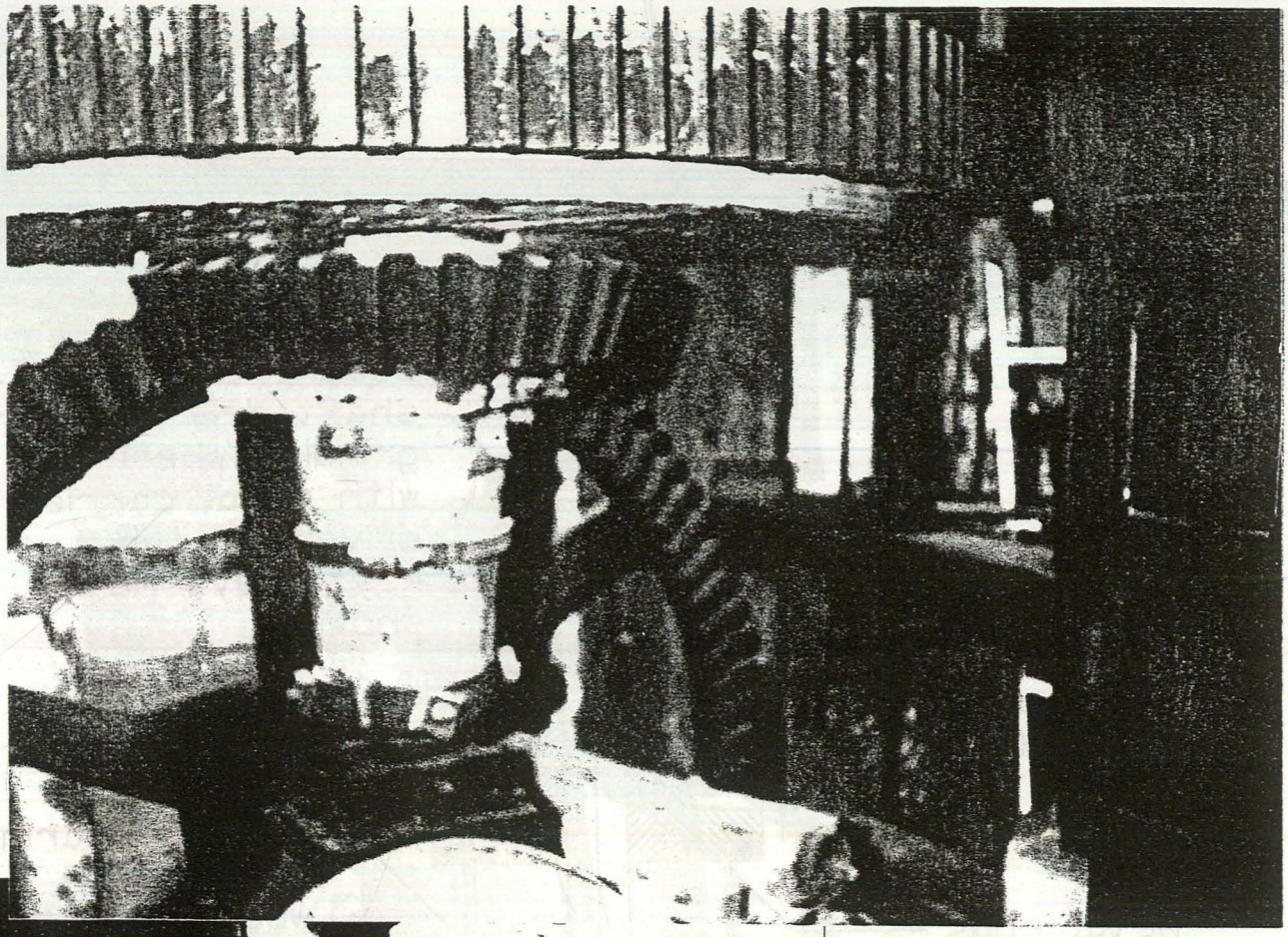
Photograph 19.

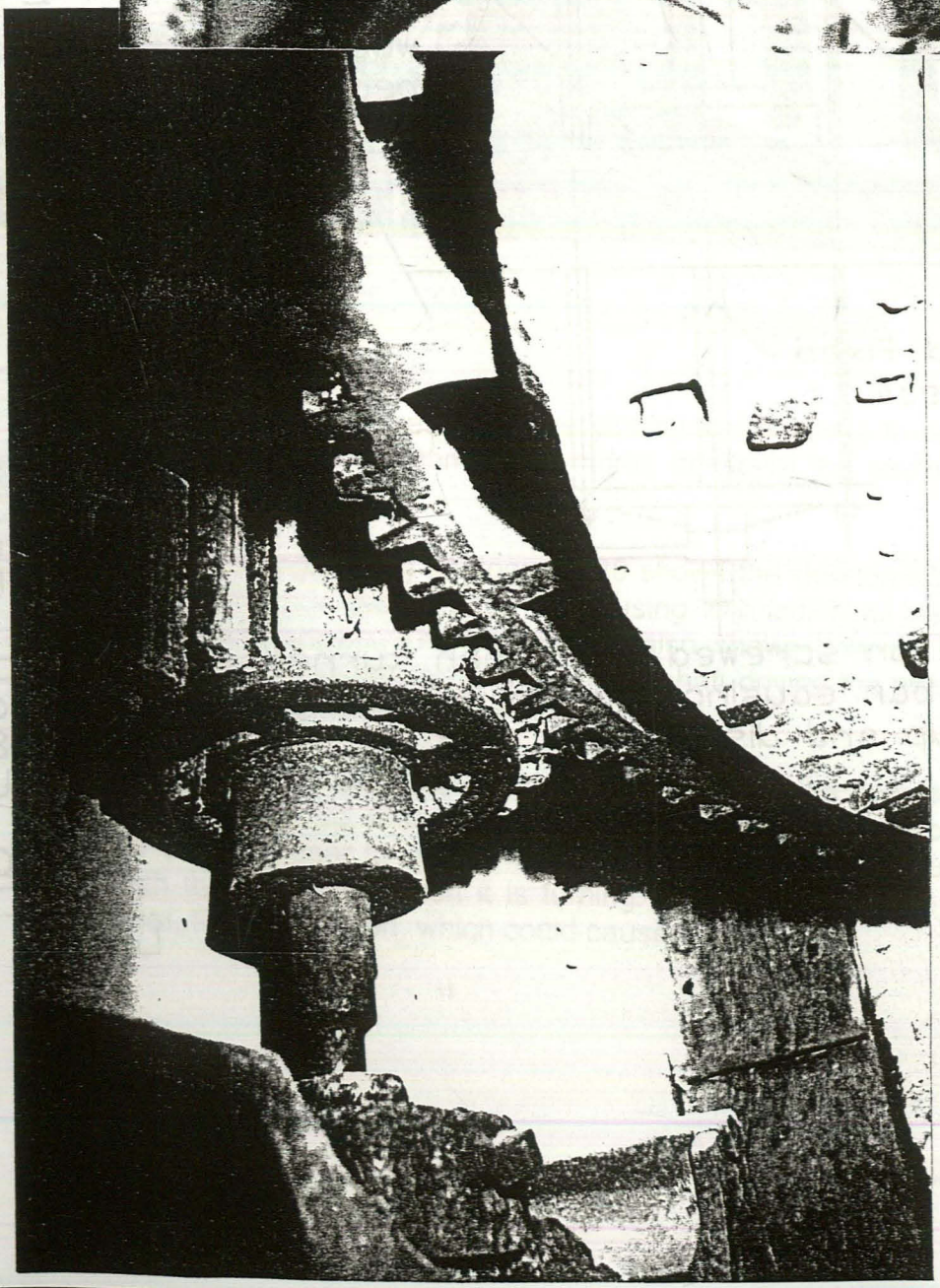


Photograph 20



Photograph 21





Photograph 22

Photograph 22 & photograph 23 left show that the construction of the large spur on the drive from the north mill wheel is similar to that of the south millwheel. Note on photographs 23 the small spur gear which has wooden teeth driven into a metal housing.

Photograph 23.

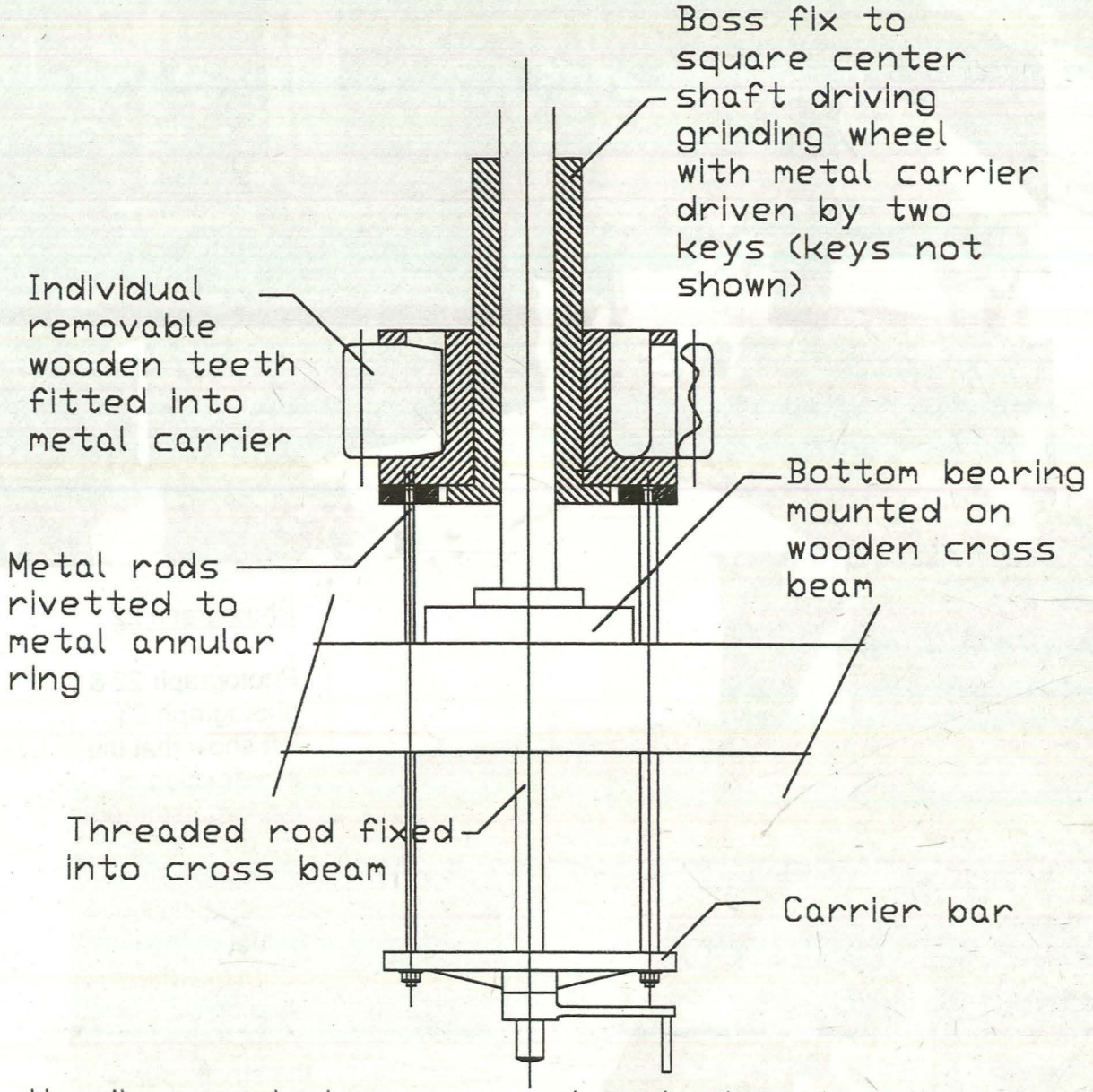
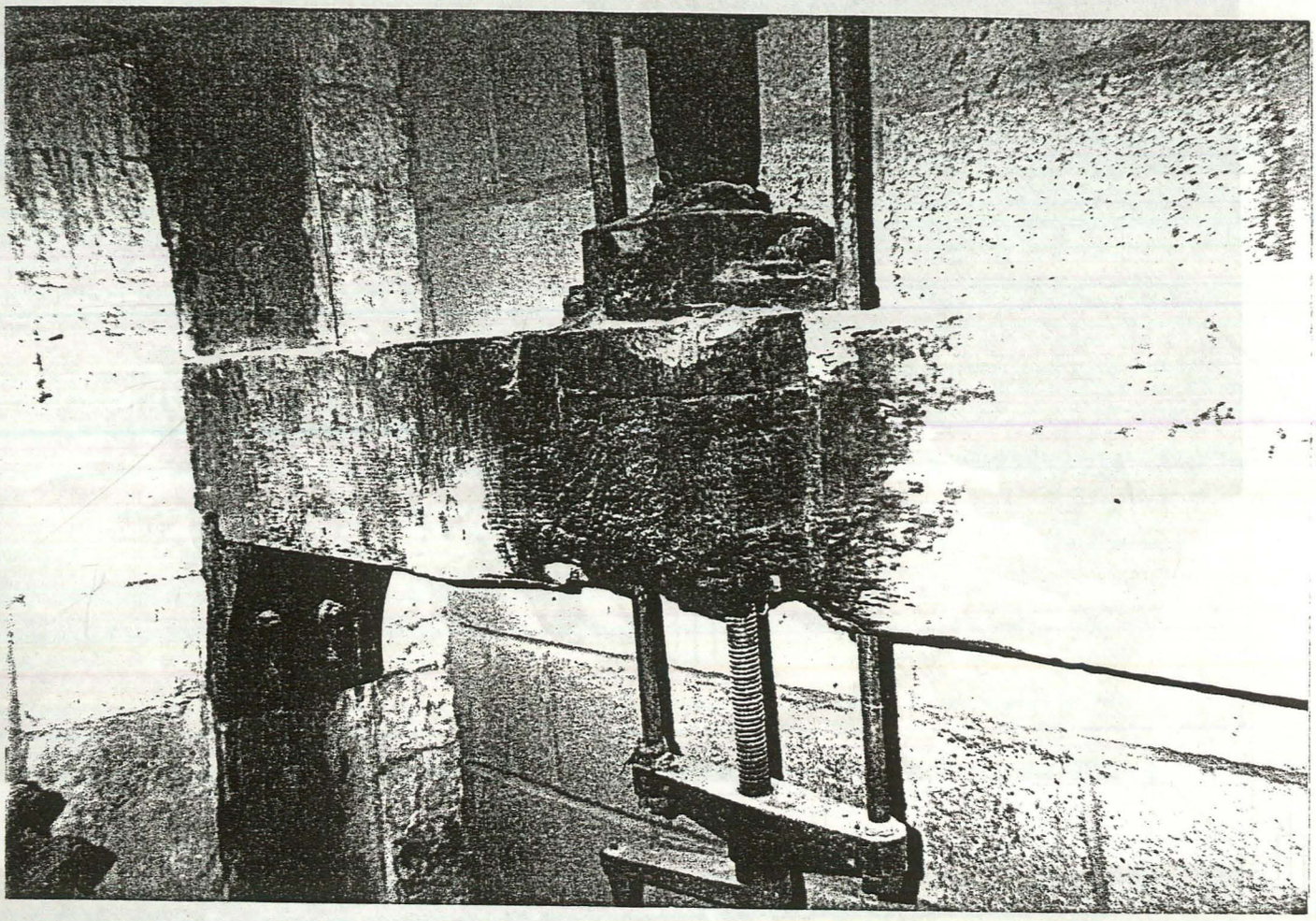



Fig 9
Schematic drawing showing method of jacking up small spur gear to disengage grinding wheel

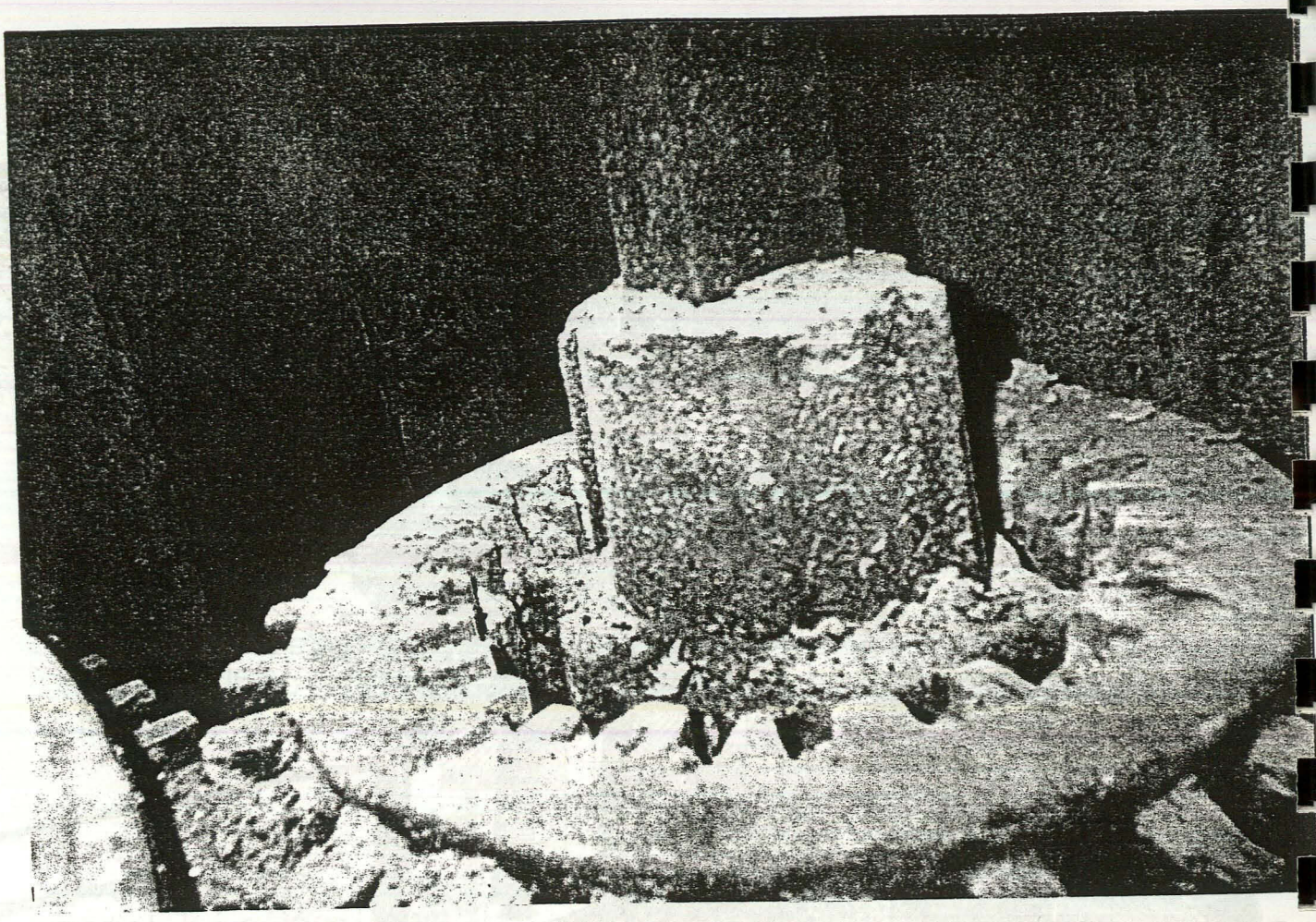


Photograph 24

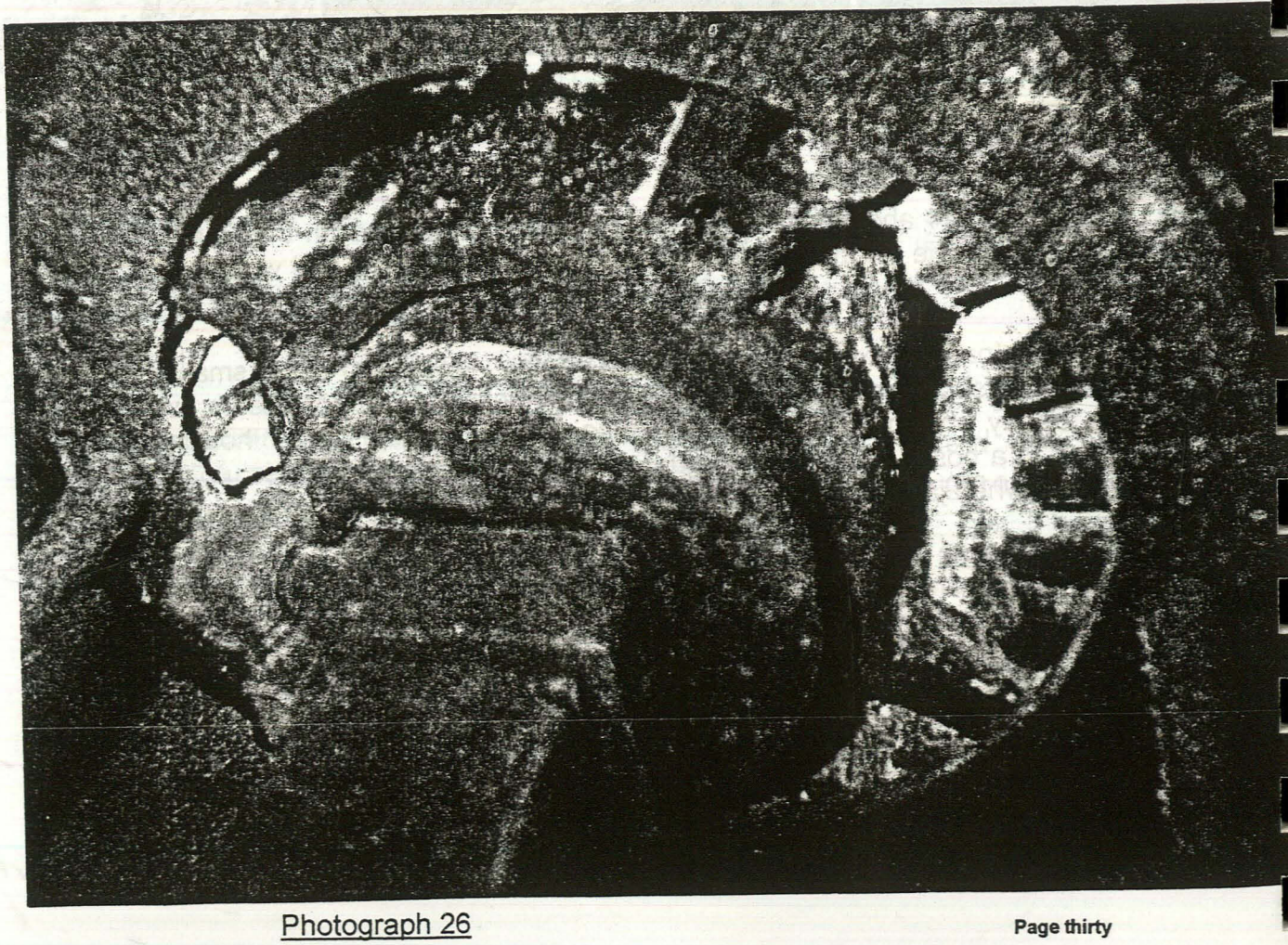
Photograph 24 above shows the jacking system used to push the small spur gear driving the left hand grind stone, driven by the south mill wheel, out of mesh.

Overleaf (page thirty) photograph 25 shows the view on top of the small spur gear. The spur gear is a carrier housing with individual wooden teeth, which are clearly shown. The photograph also shows how the carrier housing is keyed to a boss, affixed to the square shaft driving the grindstones, up which it slides when jacked from below.

Photograph 26 shows the view from below and the annular ring that pushes the spur gear up. It should be noted that there is a flange on the central boss for the spur gear to sit so that the annular ring can be lowered out of contact with the spur gear when it is turning. If it were in contact it would generate heat, through friction, which could cause a fire.



Photograph 25



Photograph 26

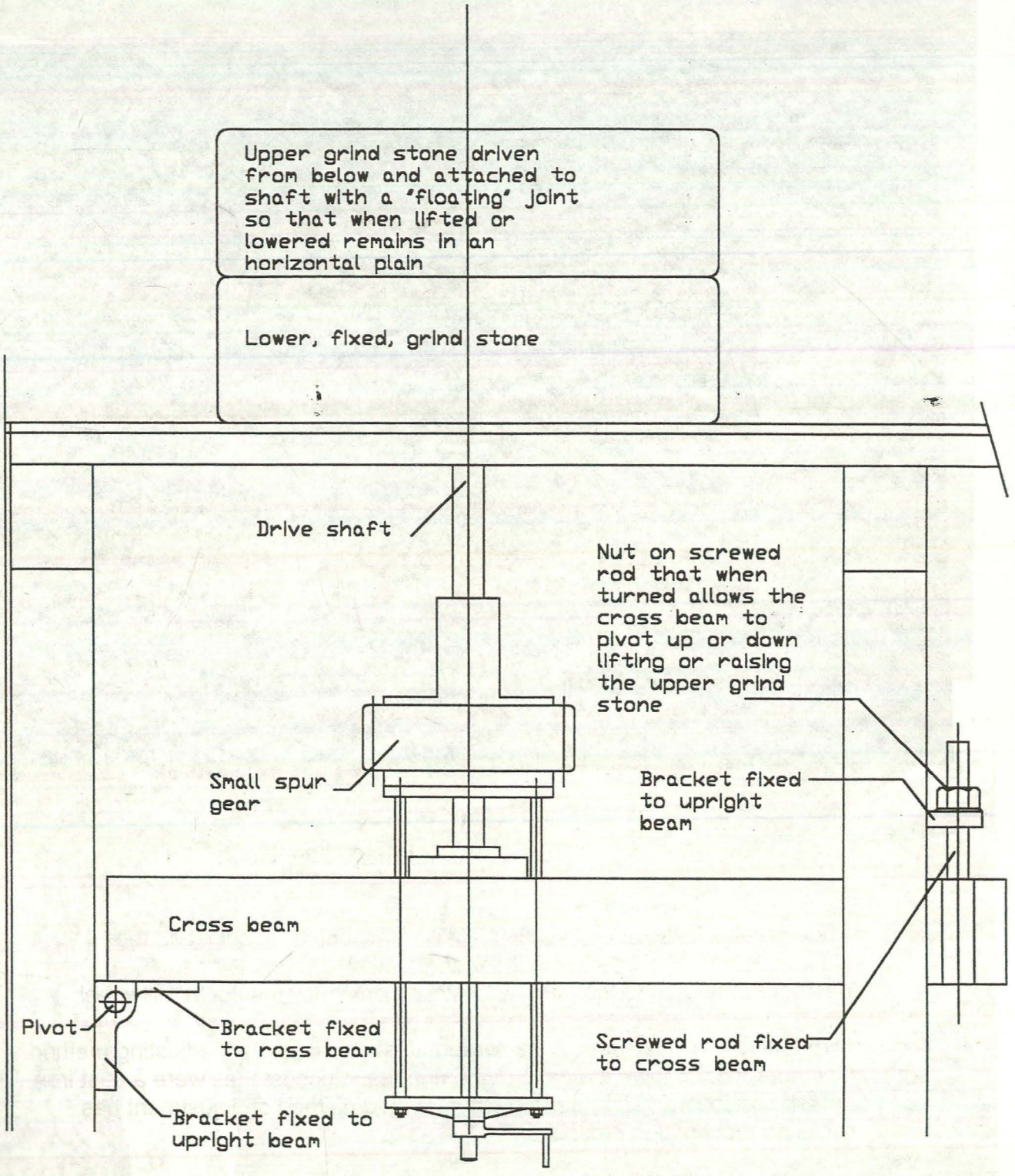
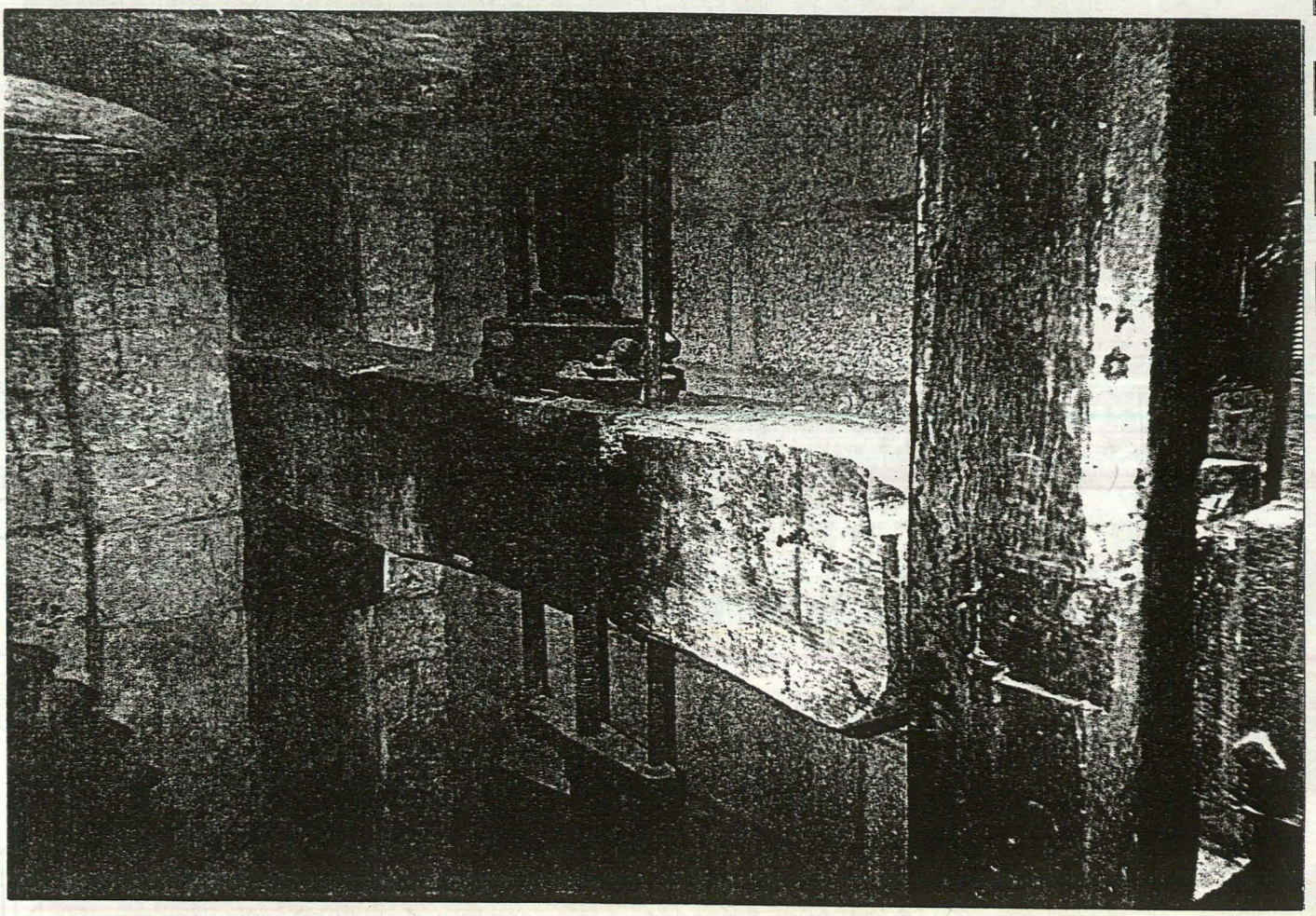



Fig 10
Schematic drawing showing method of raising and lowering the grind stone to adjust the gap and fineness of the grind

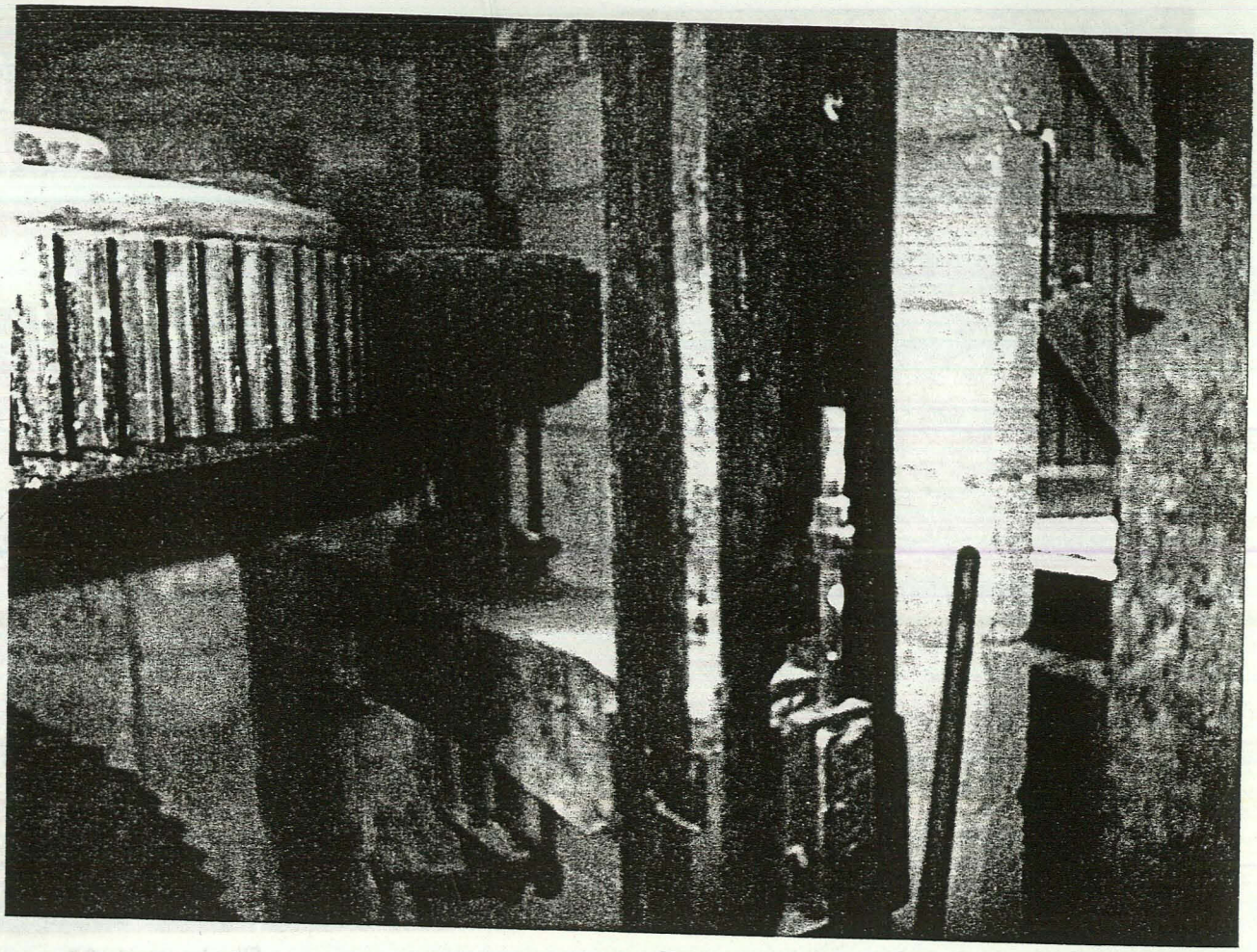


Photograph 27

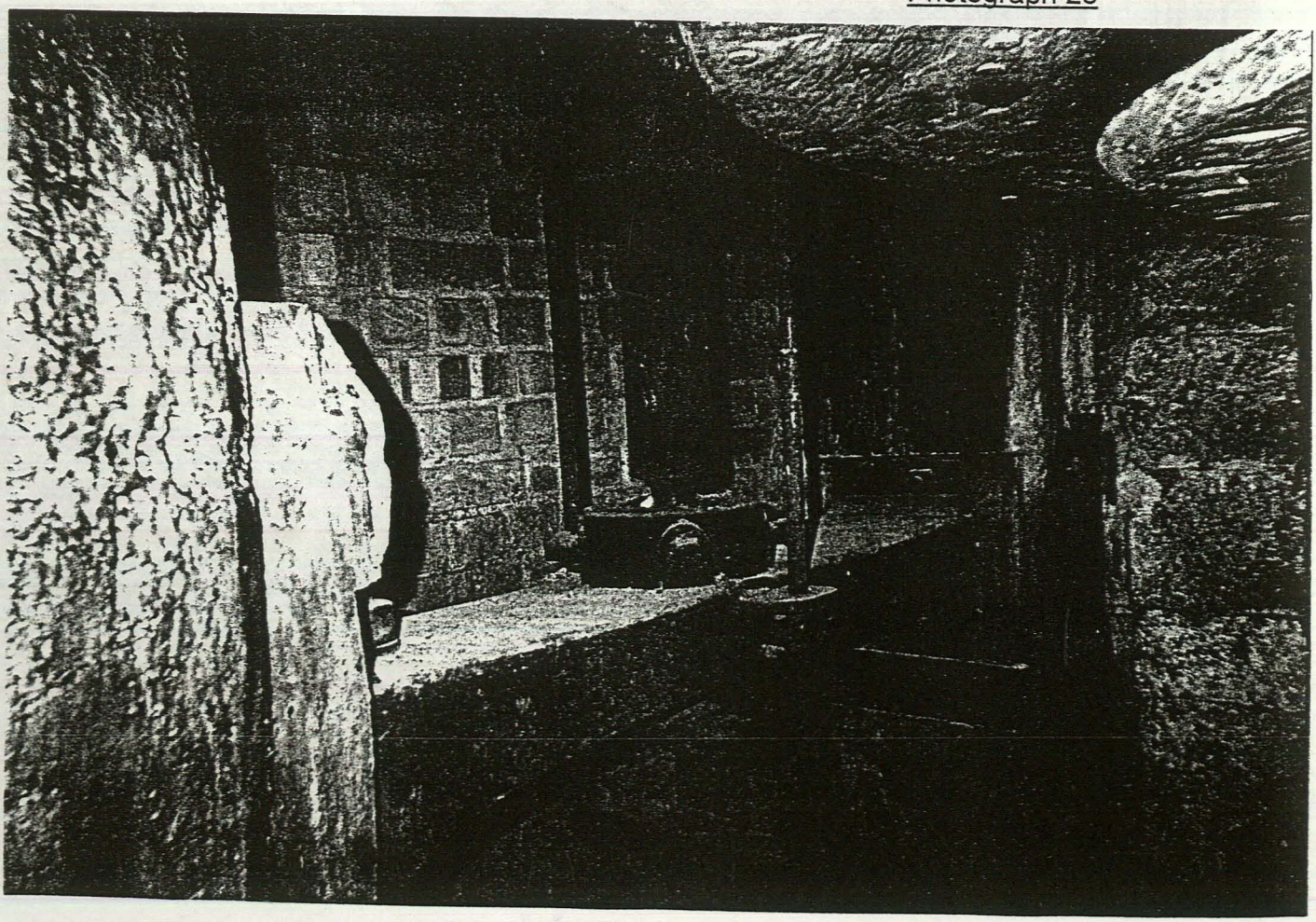
Photograph 27 above shows the pivoting crossbeam for adjusting the clearance between the fixed bottom and rotating top grindstones. The photograph relates to the right hand stones driven by the south millwheel.

Overleaf (page thirty-three) photograph 28 shows the screw adjusting method. Photograph 29 shows the drive to the right hand grindstones were a cast iron crossbeam incorporating a more sophisticated method of adjustment has replaced the wooden crossbeam.

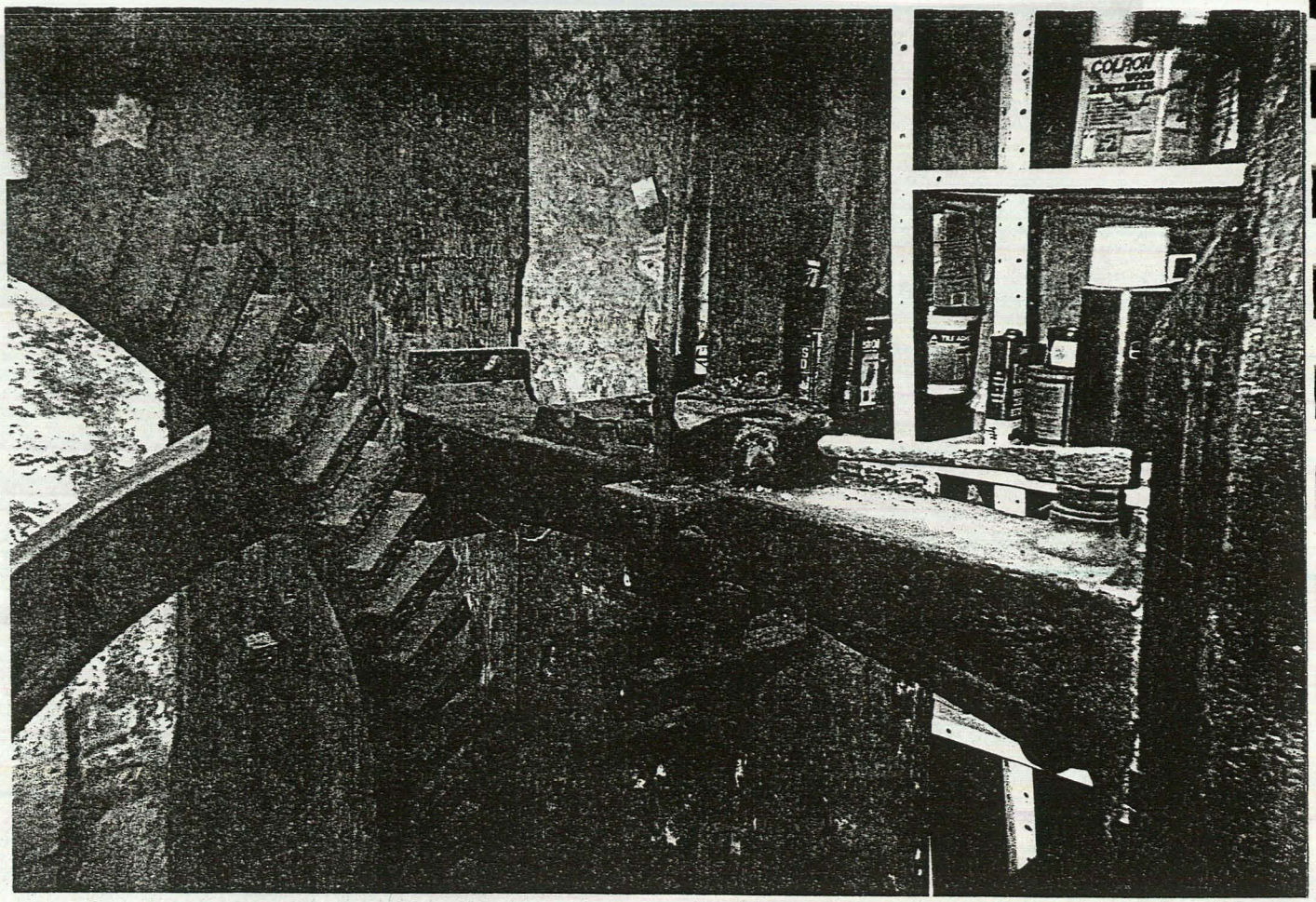
This is more clearly shown on photograph 30 (page thirty-four) where a similar system is employed on the right hand grindstone of the pair driven by the north millwheel. Photograph 31 shows the simpler adjustment used on the left hand grindstone driven from the north millwheel.



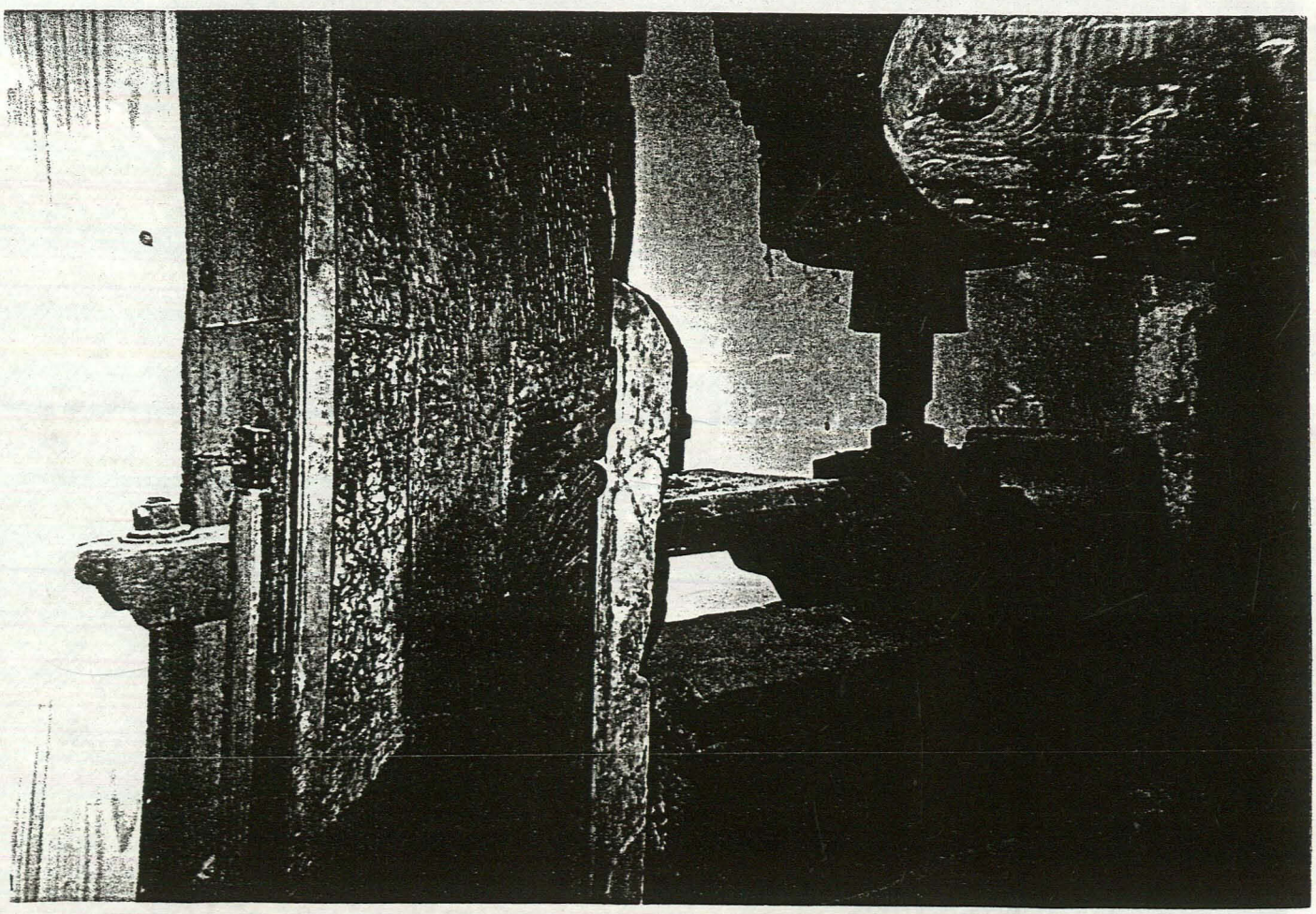
Photograph 28



Photograph 29




Photograph 30



Photograph 31