

4.1.5 Cap

cap, top winders

The *cap* of *top winders* is not attached to the trunk and can be swiveled 360° in any wind direction. This is done with the luffing gear (Fig. 4.1.5.1).

*sheers, weatherbeam, headstock/
storm beam, long sprout/ long beam/
centre beam, spindle beam, tail
beam, short sprout/short beam*

The key cap components are the two *sheers*, on or between which lie the *weather-beam*, the *headstock* (or *storm beam*) and/or the *long sprout* (*long beam*, sometimes a 'centre beam'), the *spindle beam*, the *tail beam* and the *short sprout* (*short beam*). One preferred making sheers from crooked trees, using the crookedness, on the one hand, to provide sufficient space for the brake wheel and the brake and, on the other hand, to keep the weather beam as short as possible.

jack beam/ mayor

The heaviest beam, the weatherbeam, is anchored with dove-tail joints and bolts to the front end of the sheers. It is given extra support by a *jack beam*, also called a *mayor* (in some mills sometimes three or four are used, together they are called '*mayor and eldermen*'). The weatherbeam is additionally fixed with goosenecks so that it cannot tip over outwards.

*front cowl
corner posts, neck stud/weather stud
front cowl joist*

Placed on the weatherbeam is the *front cowl*, which slopes slightly backwards to the inside. It consists of two *corner posts*, two *neck studs* or *weather studs* and, resting on those, the *front cowl joist*. One of the neck studs is additionally braced or it has a heavier design at the base in order to take the sideward pressure of the turning wind shaft. The opposite weather stud can be removed for purposes of inserting a wooden wind shaft or an iron shaft complete with inserts.

*side boards
storm hatch/weather shutter*

The front of the cap is covered by two *side boards* and on the outside fitted with two *storm hatches*, also called *weather shutters*. The latter can be removed for purposes of carrying out work on the sails or the cap.

*stone bed
knot-free deal wood, neck bearing*

In the center of the weatherbeam rests the *stone bed*, a stack of wedges and planks, of which the top one must be *knot-free deal wood* to allow the *neck bearing* to settle as evenly as possible. The neck bearing rests at the same angle as the wind shaft. Precisely because of the wedge shape of the stone bed and the pressure of the wind shaft, the neck bearing tends to move forwards. To prevent this a *neck bearing board* (or *block board*), which is a thick wooden or metal plate or an iron bow, is placed in front of the neck bearing, against the neck stud. The *head stock* provides cohesion to the sheers by means of fixed wooden connections. The rear of the jack beam is attached under or in the head stock. Next is the *long sprout/long beam*, which is anchored to the sheers and extends on both sides far out of the sheers and the cap.

bearing board/block board

head stock/storm beam

long sprout/long beam

sprattle beam

The *sprattle beam* can be adjusted horizontally so that the top bearing of the main shaft can be placed in the middle of the cap. In the center of the sprattle beam a space has been left for the top bearing of the main shaft. In certain areas of the country, the long sprout extends through the center of the cap and is therefore sometimes called *centre beam*. The sprattle beam is, in most cases, omitted then. The top bearing is then mounted in the long sprout, which is not adjustable.

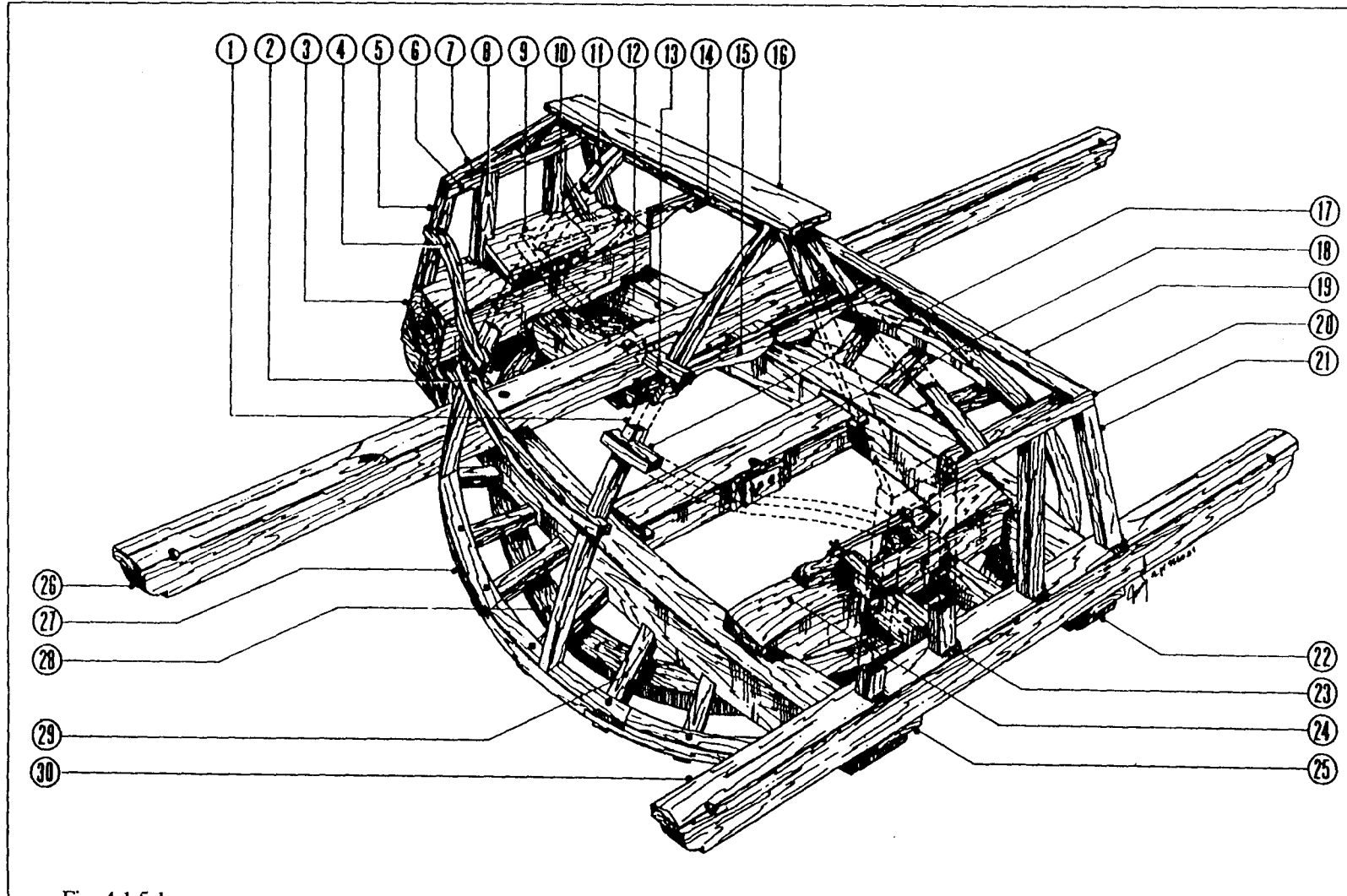


Fig. 4.1.5.1

Mill cap construction with a cap circle (for live curb or dead curb with skid blocks); the long sprout lies in front of the brake wheel.

- | | | | | |
|---------------------|----------------------------|-------------------------------|--------------------------------------|------------------------------|
| 1. cap rib | 8. neck stud/weather stud | 15. purlin, tie beam | 22. right sheer | 29. grate / <i>sun beams</i> |
| 2. purlin/girder | 9. stone bed | 16. ridge plank | 23. tail beam support | 30. short sprout |
| 3. weatherbeam | 10. neck stud/weather stud | 17. purlin/girder | 24. tail bearing beam | |
| 4. purlin/girder | 11. cap rib | 18. sprattle beam/centre beam | 25. left sheer | |
| 5. corner post | 12. headstock/storm beam | 19. hipped roof/h. gable | 26. long sprout / <i>center beam</i> | |
| 6. front cowl joist | 13. purlin/girder | 20. (ab)aftcowl beam | 27. cap rafter circle | |
| 7. cowl girder | 14. roof ridge | 21. corner post | 28. cap circle | |

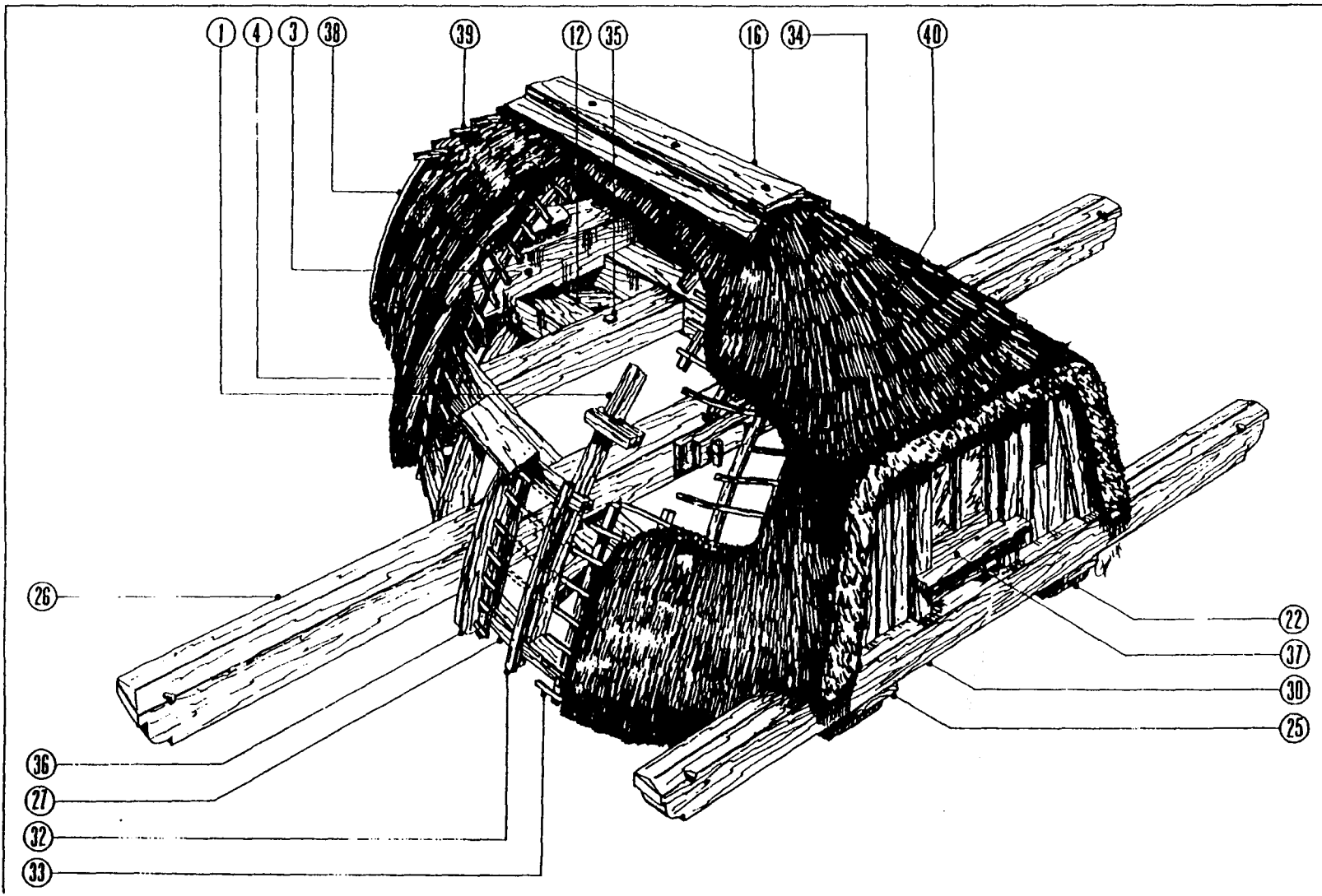


Fig. 4.1.5.2

Mill cap construction with a dead curb; the long sprout lies in the center of the cap.

- | | | | | |
|---------------------|-----------------------------|-----------------------|--------------------------|------------------|
| 1. cap rib | 16. ridge plank | 27. cap rafter circle | 34. thatch | 38. side board |
| 3. weatherbeam | 22. right sheer | 30. short sprout | 35. headstock/storm beam | 39. storm shield |
| 4. purlin/girder | 25. left sheer | 32. reed lath | 36. sprout hatch | 40. hipped roof |
| 12. jack-beam/mayor | 26. long sprout/centre beam | 33. flexible lath | 37. (ab)aftcowl | |

<p><i>tail bearing beam</i> <i>tail thrust</i></p> <p><i>tail bearing</i></p>	<p>The <i>tail bearing beam</i> is also adjustable and rests on and between the sheers. In the center lies the <i>tail thrust bearing</i> in which the rear end of the windshaft turns. The tail bearing beam is usually mounted in the sheers at the same angle as the windshaft and is often bent downwards. It not only supports the <i>tail bearing</i> but also takes the pressure which the wind exerts on the sails.</p>
<p><i>short sprout/short beam</i></p> <p><i>tail piece</i></p>	<p>The final connection between the sheers is the <i>short sprout</i>. It lies on the rear ends of the sheers. Just as the long sprout, it is part of the tail. It is half as long as the long sprout and therefore projects less from the sheers and the cap. The name '<i>tail piece</i>' is used in the case of inside winders. The beam does not project out of the cap.</p>
<p><i>(ab)aftcowl</i> <i>aftcowl joist</i></p>	<p>Mounted vertically on the short sprout is the <i>aftcowl</i>, which is often fitted with crossbar windows and/or hatches. The <i>aftcowl joist</i> is usually the upper closure of the aftcowl.</p>
<p><i>tail pole</i> <i>capstan wheel, winch, long braces</i></p>	<p>Suspended vertically in the center of the short sprout and obliquely tilted back and downwards, is the <i>tail pole</i>. The tail consists of the above-mentioned tail pole, fitted underneath with a <i>capstan wheel</i> or <i>winch</i>, two <i>long braces</i> between the long sprout and a tail pole (see 4.8.3.1).</p>
<p><i>circular curb</i> <i>sunbeams/grates</i></p> <p><i>cap rafter circle, cap ribs</i> <i>thatch laths, storm shield,</i> <i>hipped roof,</i> <i>ridge pole, purlins</i></p>	<p>The cap, as has been described so far, lies with the sheers on a <i>circular curb</i>. In the sheers are mounted the <i>sunbeams</i> or <i>grates</i>, the inside ends of which point to the center of the cap and they are fastened into the sheers with tenons. The <i>cap rafter circle</i> rests on the outside ends of the sunbeams and supports the two <i>cap ribs</i> and the <i>thatch laths</i>. The <i>storm shield</i>, the <i>hipped roof</i>, the <i>ridge pole</i>, and the <i>purlins</i>, which connect the front and aft cowls to the rafters, give the cap its usually handsome design.</p>
<p><i>flexible laths</i></p>	<p>This completes the description of the cap frame. Finally, the <i>flexible laths</i> are nailed in a wavy pattern over the reed laths. When the cap is covered with wood, the reed laths and thatch laths are omitted.</p>
<p><i>beard, date board</i></p> <p><i>duiveljager</i></p>	<p>Under the weatherbeam there often is a beautifully decorated <i>beard</i> or <i>date board</i> indicating the name and the construction year of the mill. The date board protects the part of the luffing gear under the weatherbeam against the influence of the weather. The four sheer heads, the head of the support(s) and the sunbeams are often finished with a <i>duiveljager</i> (lit. devil chaser) and painted red.</p>

4.2 WINDING CAP

Table of contents

- 4.2.0 Introduction
- 4.2.1 Round brick or stone inside winder
- 4.2.2 Wooden inside winder
- 4.2.3 Outside winder
- 4.2.4 Capstan wheel etc.
- 4.2.5 Winch

4.2.0 Introduction

Due to the constantly changing direction of the wind, the mills have been built in such a way that the cap and sails can be turned to the wind. This turning of the cap into the wind is called winding. In the case of most mills, winding is done outside. However, there are mills in which this is done inside.

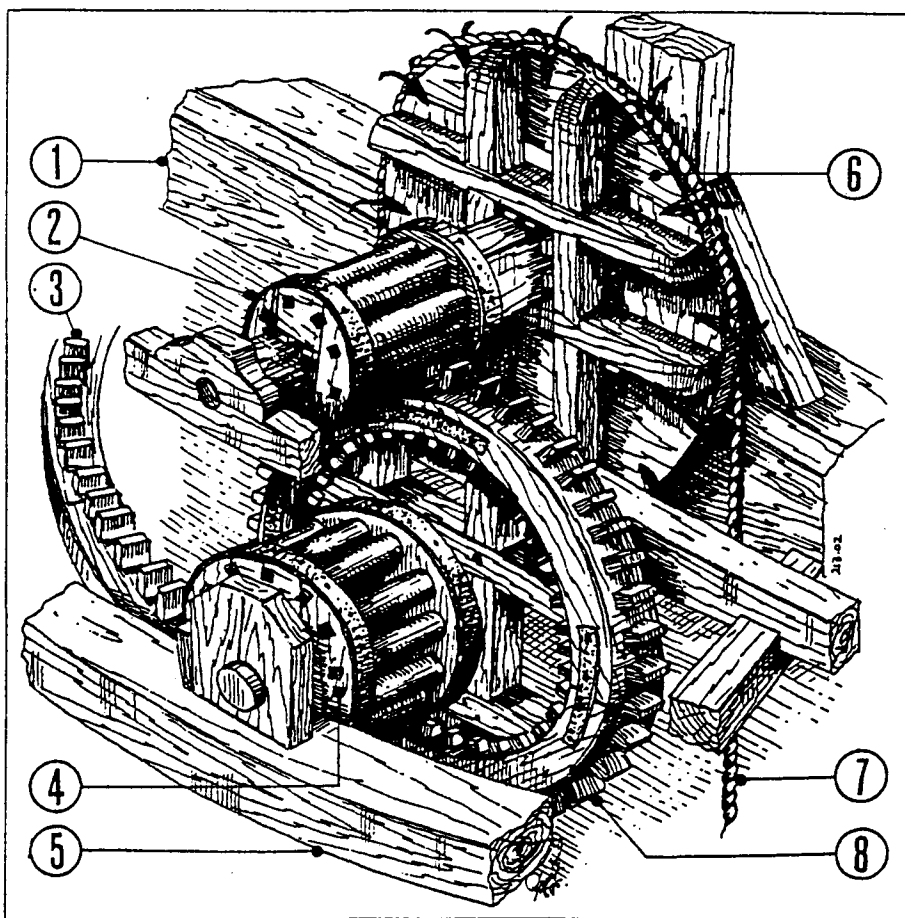


Fig. 4.2.1.1
Example of luffing gear
as found in a tower mill

- 1. sheer
- 2. lantern pinion
- 3. rack
- 4. second disc wheel
- 5. cap circle
- 6. gable wheel
- 7. gable rope
- 8. winding axle wheel

inside winder, top winder

*gable rope, gable wheel
disc wheel, cogwheel
cog ring*

rack and pinion

4.2.1 Round brick or stone inside winder

An *inside winder* is a *top winder*, i.e. a mill whose cap is turned from the inside into the eye of the wind. On the basis of the historical records, we may presume that inside winding is some 200 years older than outside winding, which arose in the second half of the sixteenth century.

Winding occurs by means of a *gable rope* in a *gable wheel*, which via a small *disc wheel* drives a large *cogwheel* fastened to a lower-placed axle. A second disc wheel on this axle meshes into the cogs of a wooden *cog ring* which rests on wooden cantilevers located inside the walls of the mill. The whole construction is called *rack and pinion*. These oldest constructions are much more complex than the 'simple' inside luffing gear of a wooden octagon described below.

4.2.2 Wooden inside winder

Wooden octagonal inside winders in the Netherlands are almost exclusively found in the province of North-Holland. With their ample caps (± 6.00 meter diameter) necessary to hold the luffing gear, they produce a powerful impression in the landscape. In all octagonal inside winders the luffing gear hangs between the sheers directly behind the weatherbeam. It has been positioned as far as possible from the center of the cap to enable it to exert greater force.

*capstan wheel
winding rope, pulley block
cramp-iron*

The *capstan wheel* has ten to fourteen staves and its handles are reinforced by circle girders. Winding occurs with the *winding rope* and the *pulley block*. The pulley block is suspended from a hook in a '*cramp-iron*', sixteen of which are mounted to the upper entablature, i.e. two per entablature piece. Without use of the pulley block, it would be a heavy chore to turn the cap to the wind.

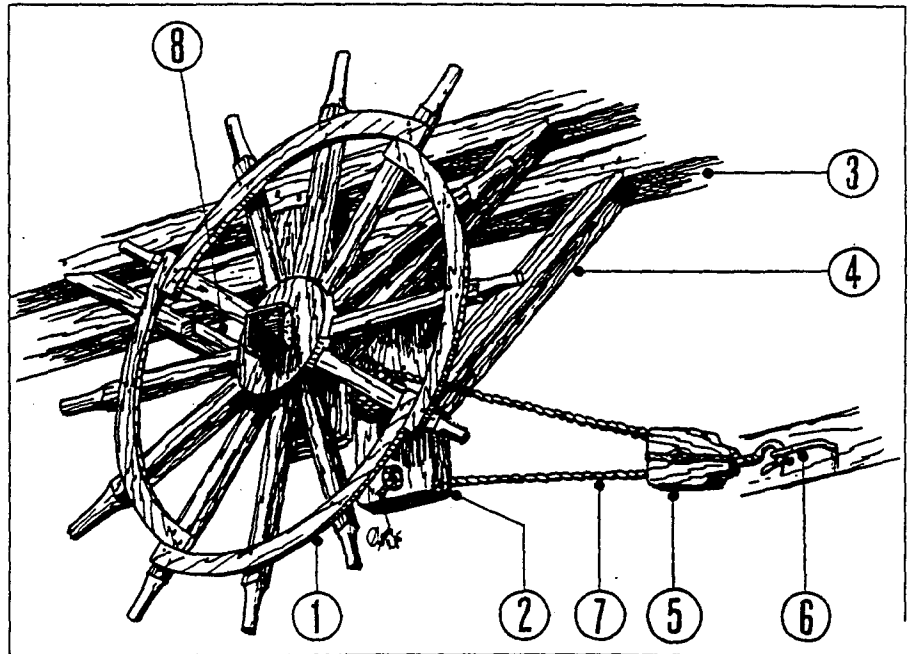
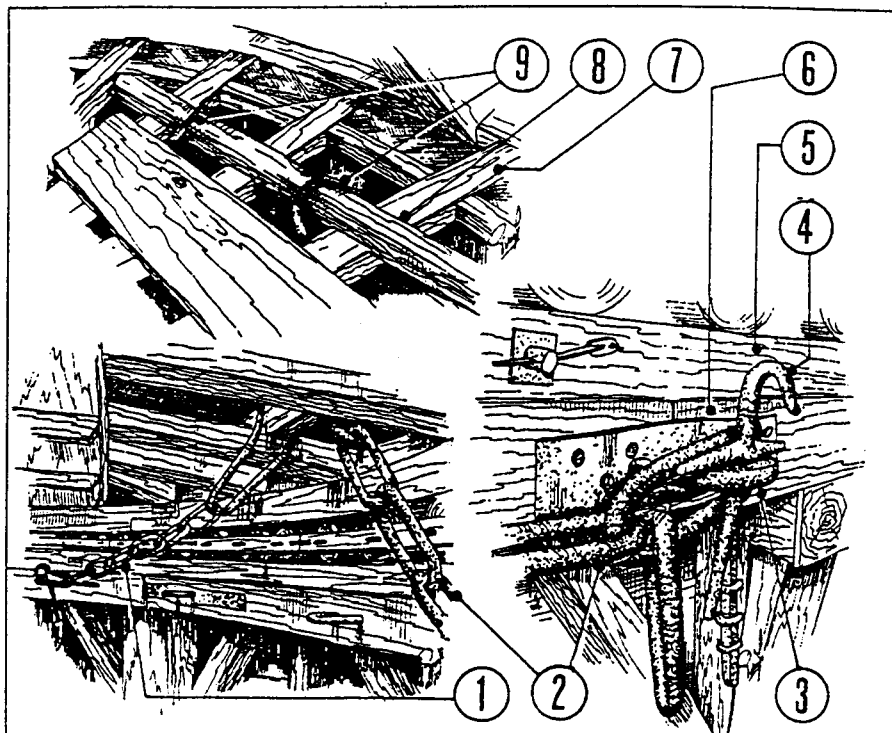


Fig. 4.2.2.1
Luffing gear of an inside winder

1. capstan wheel
2. poll
3. hanger-beam ('hanger-niersbalk')
4. brace
5. pulley block
6. cramp-iron
7. winding rope
8. ratchet

Fig. 4.2.2.2
Anchor chain and dead-chain
 1. *anchor chain*
 2. *dead chain*
 3. *cramp(iron)*
 4. *locking pin*
 5. *live curb*
 6. *upper entablature*
 7. *sunbeam / grate*
 8. *beam for the chains*
 9. *eye for anchor chain and dead chain*



anchor chain, dead chain

locking pin

catch

long brace
short brace

Every inside winder has an *anchor chain* and a *dead chain*. These hang from a beam fastened parallel to the left sheer on the sunbeams (or grates). The links of both chains are long enough to fit over a cramp and they are secured with a cross-shaped iron, the so-called '*locking pin*'. After turning the sails to the wind, the miller fixes the cap with the anchor chain and the winding rope to prevent it from moving about. He then secures the capstan wheel with a *catch*. For, during grinding the cap has a tendency to turn to the right.

4.2.3 Outside winder

Many top winders were given a tail after the second half of the sixteenth century, enabling the miller to turn the cap into the wind at ground level outside the mill. This was in fact an adaptation of the winding that had already been used

for centuries in post mills and later in wip mills. The primary reason why the tail was introduced was naturally that the miller could now perform all activities on the ground rather than having to go to the top of the mill to turn it to the wind.

The tail of a top winder consists of a tailpole, two *long braces* connected to the long sprout and two *short braces* connected to the short sprout (Fig. 4.2.3.1). The tailpole is suspended obliquely back and downwards from the short beam by means of a notch and a heavy bolt. The lower part is usually thicker because it contains a hole for the capstan wheel. Moreover, the lower part of the tailpole is put under the heaviest load during winding and grinding.

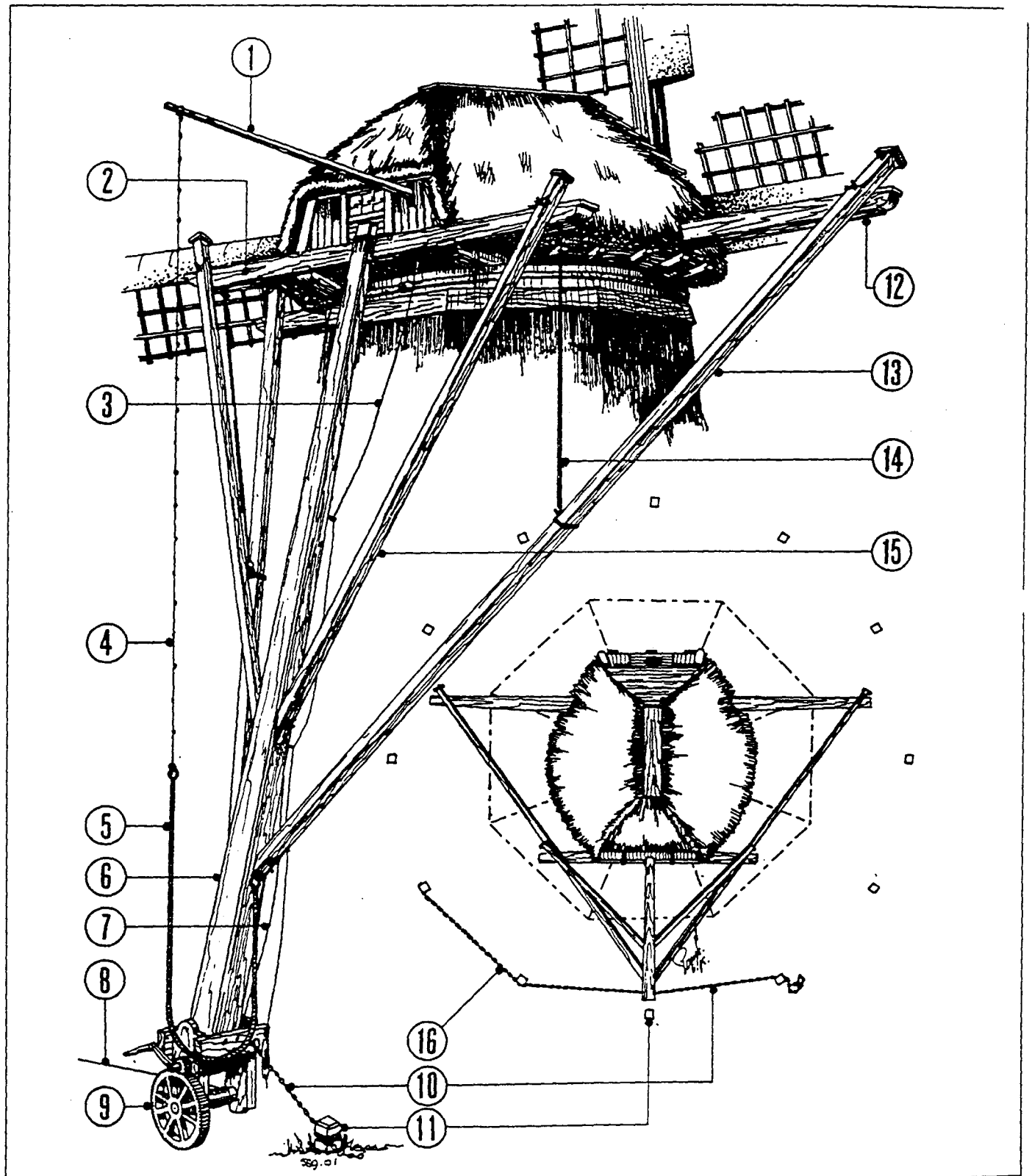


Fig. 4.2.3.1

Outside winder

- | | | |
|-----------------|------------------|---------------------------|
| 1. brake pole | 6. tailpole | 11. chain post |
| 2. short sprout | 7. catch rope | 12. long sprout |
| 3. 'dog' rope | 8. winding rope | 13. long brace |
| 4. brake chain | 9. winch | 14. hanger bar (or chain) |
| 5. brake rope | 10. anchor chain | 15. short brace |
| | | 16. winding chain |

cap

The long braces rest on the ends of the long beam by means of a notch and fastened to it with a cotter bolt. The short braces are connected to the short beam in the same way. Rectangular battens, the *caps*, are nailed to the lower part of the tailpole. These prevent water seeping into the head ends of the braces, which would cause the connection with the long beam to rot away too rapidly. Both the short braces and the long braces are connected to the tailpole with a tenon or a straight joint and fastened with bolts. Approximately in the middle, the long braces are suspended from the short beam with chains or bars to prevent them from sagging.

4.2.4 Capstan wheel

The *capstan wheel* consists of a *monk* ('*munnik*') or capstan ('*kruias*') which is diagonally inserted in the tailpole. Because of its diagonal position, the monk slides automatically into the tail as the *winding chain* unreels. During winding, the monk slowly slides out again.

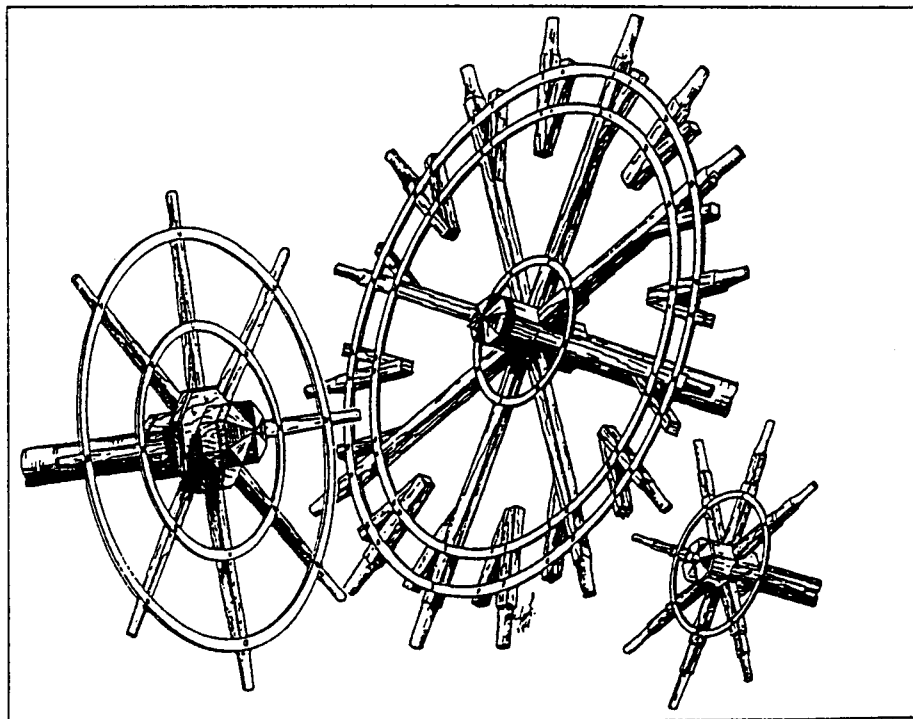


Fig. 4.2.4.1
Examples of capstan wheels
and a reel

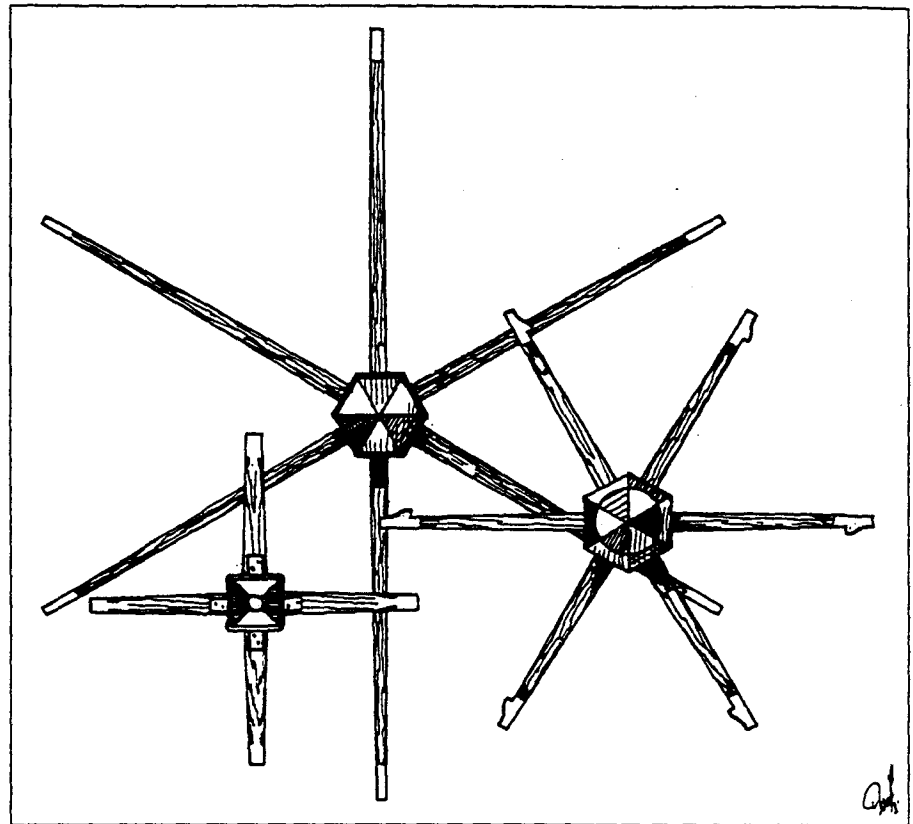


Fig. 4.2.4.2
Some examples of a winding reel

shins
spikehandles
collar
circle girders

handles
winding reel

'*windkoppel*'

winch
crank
winch barrel

To protect it from excessive wear, the monk is fitted with *shins* (*iron strips*). A number of *spikehandles* have been placed round the head of the monk and it is generally reinforced with a wooden or metal *collar*. Further reinforcement of the capstanwheel is achieved by the use one ore more metal rings, the *circle girders*.

In a capstan wheel the outer circle is fastened along the *handles* so that the miller can walk in the wheel. In a '*winding reel*', the circle is placed about half way the *spikehandles* and 'walking winding' is not possible. Furthermore, a winding reel has fewer *spikehandles* (usually six) than a capstan wheel.

The simplest form of a winding reel only has two continuing handspikes, which moreover are not inserted cross-halved through the monk but over each other. This type of construction is also called a '*windkoppel*' in the Netherlands. Here, therefore, the handspikes do not lie in a single plane.

4.2.5 Winch

The emergence of the *winch* made the task of winding easier. Via cast-iron gears the transmission could be made smaller. The ironwork of the *winch* consists in principle of a spindle, on which one or two *cranks* can be placed, with a small gear wheel meshing into a large gear wheel which is fastened with a *winch bar-*

rel to a second spindle. The small gear wheel (with 10 or 12 teeth) can, in some cases, be adjusted by sliding it along the crank spindle. This allows the winch barrel to be released for the purpose of shifting the (steel) *anchor chain*. A ratchet on one of the gear wheels is used to fix the winch and, with that, the tail. The winch comes in many designs and is fastened to the tail pole in a variety of ways, but always horizontally.

A so-called *endless chain* is placed round some mills. This chain is kept in place by iron pins and hooks sticking out of the ground or stage. The chain runs via two guide rolls around the barrel or around a wheel of the winch, and the crank only needs to be turned to the right or the left to wind the mill. Shifting the anchor chain and the winding chain is here a thing of the past.

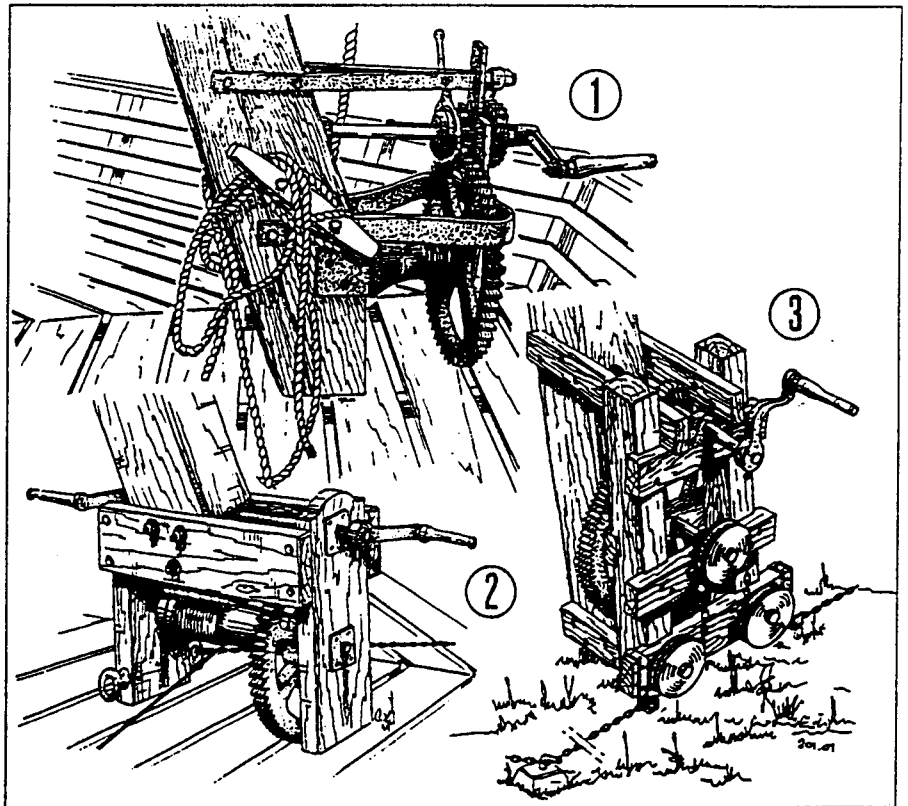


Fig. 4.2.5.J
Some examples of winches
1. iron winch
2. wooden trestle
3. winch with endless chain

4.3 LUFFING GEAR

Table of contents

- 4.3.0 Introduction
- 4.3.1 Luffing gear in top winders
 - a Curb
 - b Keep flange
 - c Wooden and cast iron rollers ('rollenkruiwark')
 - d Shot curb ('engels kruiwark')
 - e Dead curb with skid blocks ('neutenkruiwark')
 - f Dead curb ('voeghoutenkruiwark')
- 4.3.2 Collar curb ('zetelkruiwark')

4.3.0 Introduction

Contrary to what you may have read in (old) books on mills, there is no evidence at all that in Holland mills existed which could not be turned into the wind. The first windmills in Western Europe were post mills. The luffing gear used in Dutch mills has briefly been listed above. Below it is listed in full:

- | | |
|---|--|
| <p>A. Live curb</p> <ul style="list-style-type: none"> - Wooden or cast-iron rollers - Shot curb (with flanges on the rollers) - Luffing gear in paltrok mills (a mix of collar curb and wooden rollers) | <p>B. Dead curb</p> <ul style="list-style-type: none"> - Dead curb with skid blocks - dead curb with sheers - Collar curb (zetelkruiwark) |
|---|--|

In top winders we see:

- Wooden or cast-iron rollers
- Shot curbs (rollers with flanges on rails)
- Dead curb with skid blocks
- Dead curb where both sheers rest directly on the curb

In post mills, wip mills and spider mills we exclusively see a:

- collar curb (zetelkruiwark)

In paltrok mills:

- Paltrok luffing gear (outside the scope of this work)

4.3.1 Luffing gear in top winders

4.3.1.a Curb

curb floor

The *curb 'floor'* consists of a number of round pieces of wood which have been joined into a purely round ring. The upper part of the curb floor of a live curb is not completely horizontal but slight tilted downwards to the outside because the wooden or iron rollers that turn on it are conical in shape. When a dead curb is

used, the floor is horizontal. In wooden octagonal mills the curb floor is attached to the upper entablature. In stone mills the curb floor rests on the wall.

4.3.1.b Keep flange

keep flange, check flange

*flange hoop
tendency to slide*

flange nuts

The *keep flange* (*check flange*) is a wooden ring made of several pieces. This ring is firmly fixed around the outside of the curb. To make a firm unit of the constituent parts of the keep flange, there often is a tautly drawn iron clip binding round the flange: the *flange hoop*. The flange serves to keep the cap in place. During winding, the cap has a *tendency to slide* sideways off the curb. Moreover, the wind on the sails exerts backward pressure on the cap during grinding. This undesirable movement is neutralized by the keep flange.

To minimize the friction between the cap circle and the inside of the flange, vertically positioned hardwood '*nuts*', so-called '*flange nuts*', have been placed at regular distances in the keep flange.

The keep flange is absolutely necessary in mills with a wooden or cast-iron live curb and in mills with a dead curb with skid plates. In mills with a shot curb the tun may be omitted (see 4.3.1.e). In a dead curb there is no room for a keep flange (see 4.3.1.g). Here the cap is kept in place by means of centering clamps.

4.3.1.c Wooden and cast-iron live curb

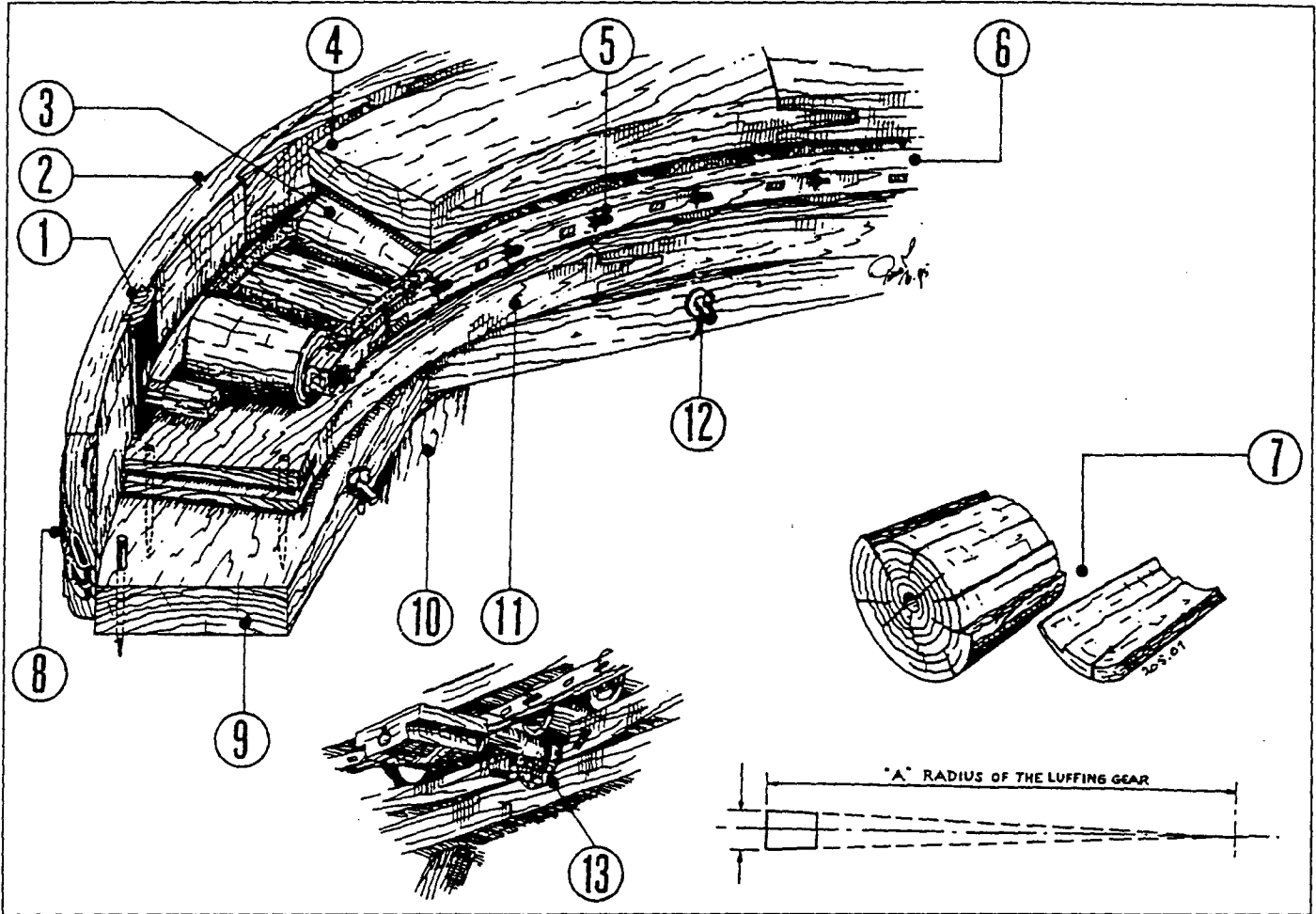


Fig. 4.3.1.1
 Example of a live curb

1. buttress block	4. cap circle	7. bursted roller	10. cantpost	13. 'roller sluice'
2. keep flange	5. roller axle	8. flange hoop	11. curb (S.A. iron)	
3. roller	6. cage	9. upper entablature	12. curb bolt	

Guiaac wood
 "pock"

Like
 Ligna vitæ
 usage orange

4.3.1.d Shot curb

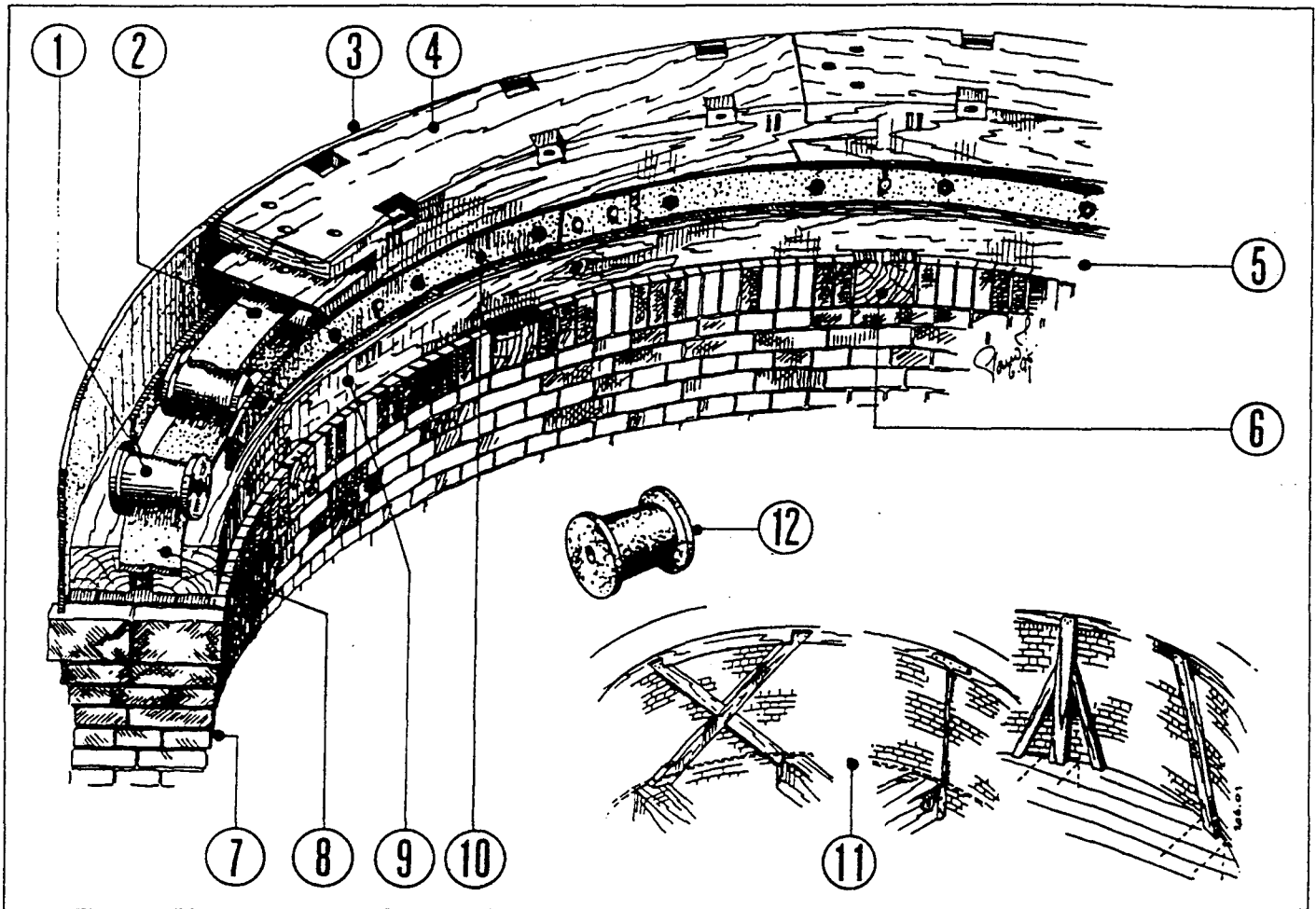


Fig. 4.3.1.2

shot curb (engels kruüwerk)

- | | | | |
|------------------|---------------|---------------|--------------------------------------|
| 1. roller | 4. cap circle | 7. wall | 10. roller circle |
| 2. upper rail | 5. curb floor | 8. under rail | 11. examples of curbs and fastenings |
| 3. flange (iron) | 6. canalever | 9. curb floor | 12. iron roller with flanges |

4.3.1.e Dead curb with skid blocks

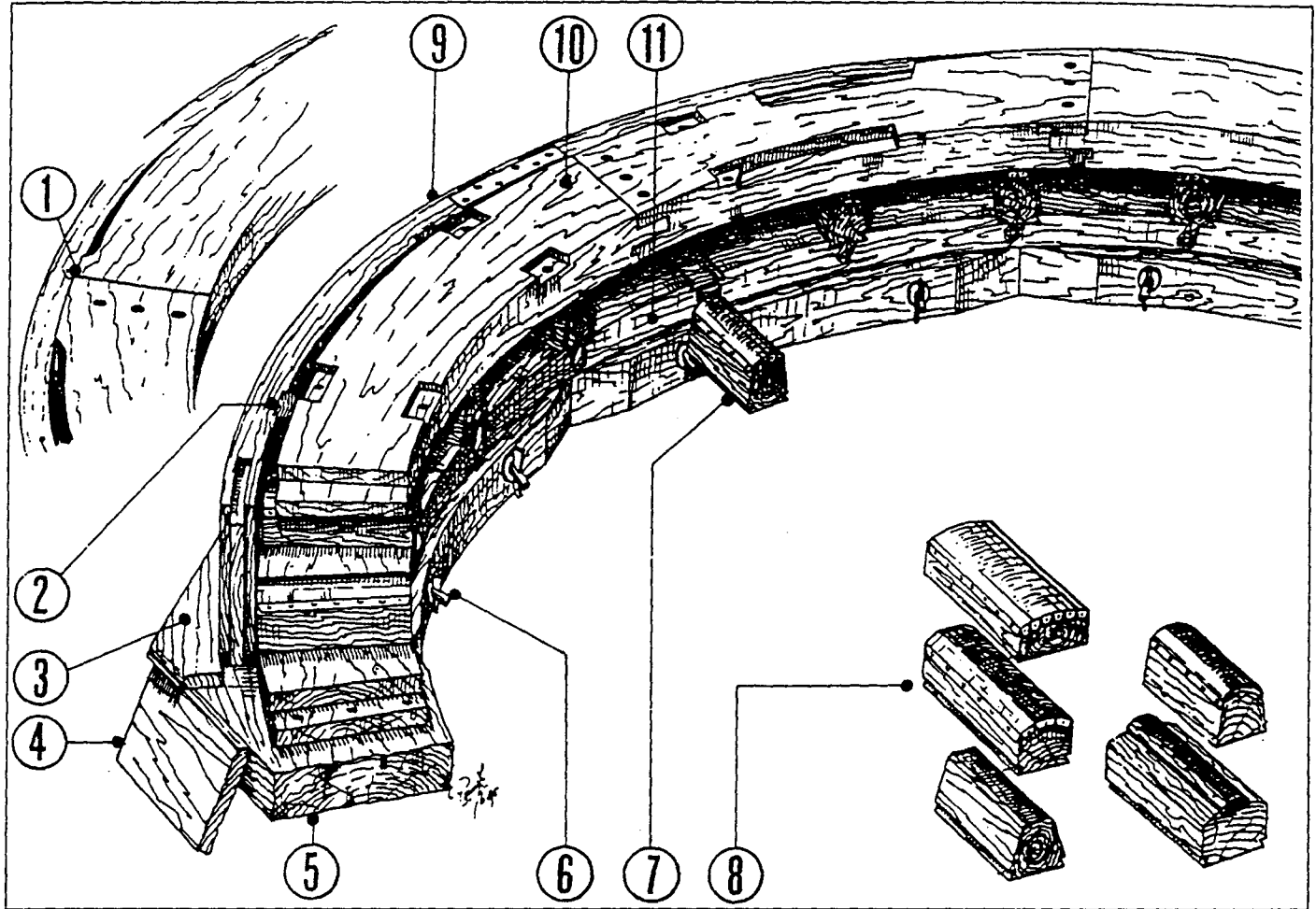


Fig. 4.3.1.3

Dead curb with skid blocks ('neutenkruitwerk')

- | | | | |
|-----------------------------------|----------------------|----------------------------|----------------|
| 1. cap circle with buttress block | 4. hatch board | 7. skid block | 9. keep flange |
| 2. buttress block | 5. upper-entablature | 8. examples of skid blocks | 10. cap circle |
| 3. starting board | 6. flange bolt | | 11. curb |

4.3.1.f *Dead curb (voeghoutenkruierwerk)*

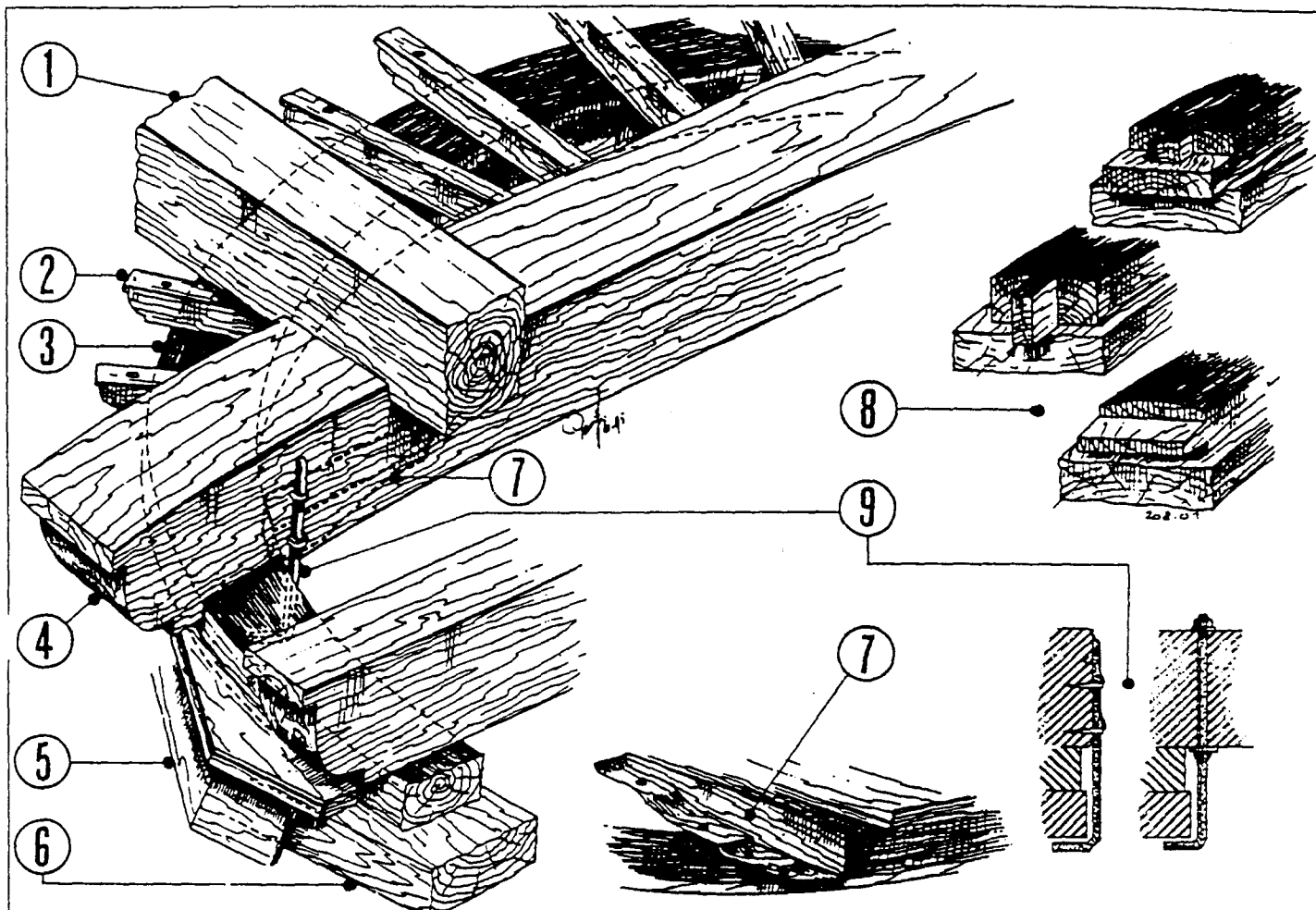


Fig. 4.3.1.4

Dead curb (voeghoutenkruierwerk)

- | | | | |
|--------------------|----------|----------------------|----------------------------|
| 1. long sprout | 3. curb | 5. thatch board | 7. centering clamp |
| 2. sunbeam / grate | 4. sheer | 6. upper entablature | 8. examples of curb joints |
| | | | 9. keep iron |

dead curb

The *dead curb*, which is often used in mills of the northern Dutch provinces, has a very simple construction. This '*slide luffing gear*' is usually found in mills with small caps.

curb

The floor of a *dead curb* is simply called a *curb* or sometimes *slide ring*. The shears rest directly on the curb; a cap circle is not used. Occasionally the shears

have grooves 3 to 5 cm deep where they rest on the curb. There are also designs in which they rest cold on the curb. In some cases the sheers are fitted with a metal anti-wear lining. The jack beam and the grates slide along over the curb during winding.

centering clamps

To prevent the cap moving sideways off the winding floor, firm *centering clamps* have been attached underneath the sheers. These clamps slide along the inside of the curb.

keep irons

The cap of small mills could rise upwards during a heavy storm. To prevent this, iron *keep irons* were sometimes mounted in or against the sheers. These move along the curb and the upper entablature and are bent at right angles on the underside.

Mills with a dead curb do not have a keep flange or a cap circle.

Lubrication of the dead curb (with sheep fat or, in winter, with black grease):

- Upper part of the *curb* or '*slide ring*'.
 - Inside of the curb (if *centering clamps* are used).
-