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Medleri Charkha: A self-winding foot-operated spinning wheel

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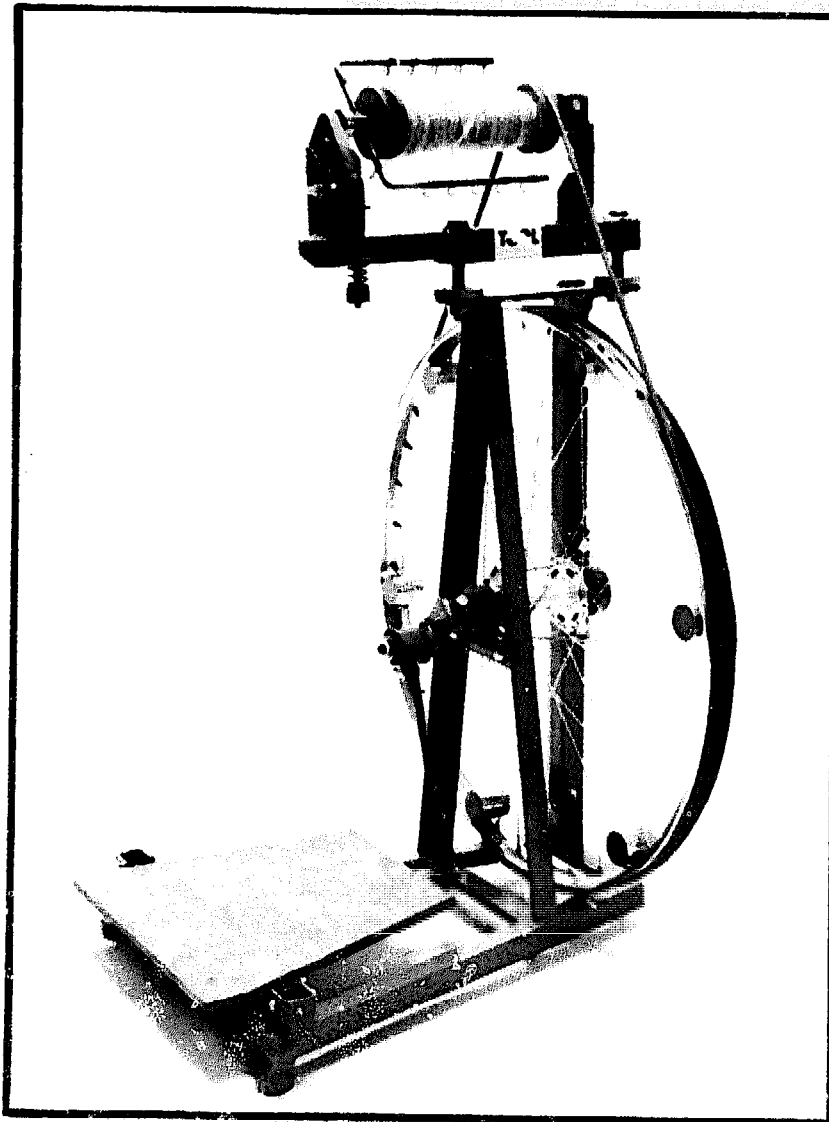
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**Operation and construction manual**

# ***Medleri Charkha***

**A self-winding foot-operated  
spinning wheel**

**Mies Bouwmeester  
Wim Bloemen**



**TOOL**

# ***Medleri***

# ***Charkha***

**A self-winding foot-operated spinning wheel**

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**Mies Bouwmeester / Wim Bloemen**

**India Development Service  
Transfer of Technology for Development**

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# 1 Introduction

This operation manual describes the operation and maintenance of the Medleri Charkha, a foot-operated self-winding spinning wheel. It was developed and tested in close co-operation with wool spinners and weavers under village conditions in Medleri, a small village in Karnataka, India. Being developed in Medleri, it got the name Medleri Charkha. Charkha is the Hindi word for spinning wheel.

It was developed by India Development Service (IDS), India, with assistance from expert engineers and spinners from the Transfer of Technology for Development Foundation (TOOL), The Netherlands.

In a two-year training programme 96 spinners in and around Medleri were trained by IDS in the use of the Medleri Charkha. The project was financed by:

- Ministry of Science and Technology, Women's Cell, Government of India.
- Lockhorn Development Foundation, The Netherlands.
- Hulsebosch Prior Foundation, The Netherlands.

## 1.1 The charkha

The Medleri Charkha combines versatility with ease of operation and is appropriate for village conditions. It produces a more even quality yarn with more twist than traditional hand-operated charkhas.

The charkha consists of a *frame* to which either a *medium yarn spinning mechanism* (for spinning up to count 4 to 5), or a *fine yarn spinning mechanism* (for spinning up to count 6 to 7) can be attached.

A *rewind spindle* is available as an accessory which can be used to rewind the spun yarn from the *bobbin* into a *kukedi* (cone of yarn).

## 1.2 This manual

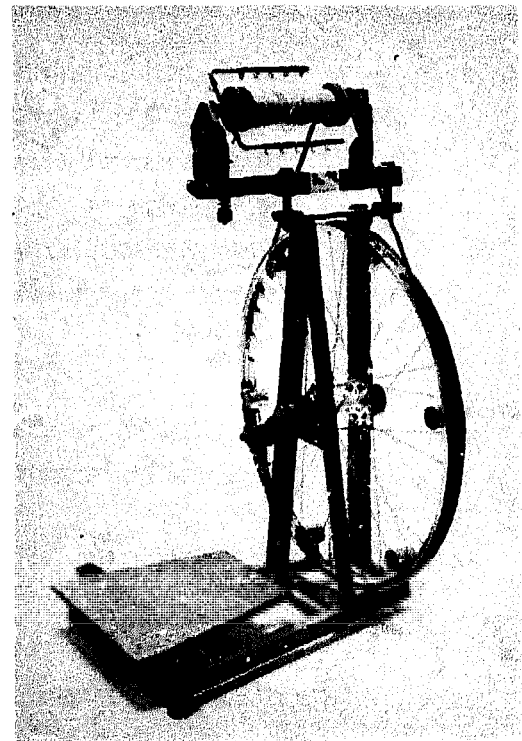
In this manual, at first the parts of the spinning wheel will be identified. The next chapters describe how to mount and remove different parts of the charkha. Then instructions for daily maintenance

are given and the spinning of woollen fibres will be explained. The operation manual concludes with a trouble-shooting list.

The parts of the Medleri Charkha mentioned in this manual are printed in an *Italic font*. These parts can be identified using the figures in Chapter 2.

### **1.3 Features of the Medleri Charkha**

- Foot-operated, with self-winding mechanism.
- Winding-speed regulated by adjustable brake mechanism.
- Possibility to mount either a fine yarn spinning mechanism or a medium yarn spinning mechanism.
- Easy adjustment of driving belt tension.
- Produces strong, even yarn for better, longer lasting products.
- Capacity at up to 1000 gram of 3 count yarn per day.
- Spinning 5 to 7 count yarn possible.
- Pre-spinning processing of wool the same as for spinning on traditional hand-operated charkhas.
- Will spin any quality of wool, both long and short fibres.
- Experienced spinners can use the charkha to spin silk or cotton fibres.
- Made from locally available parts.
- Easy to maintain.



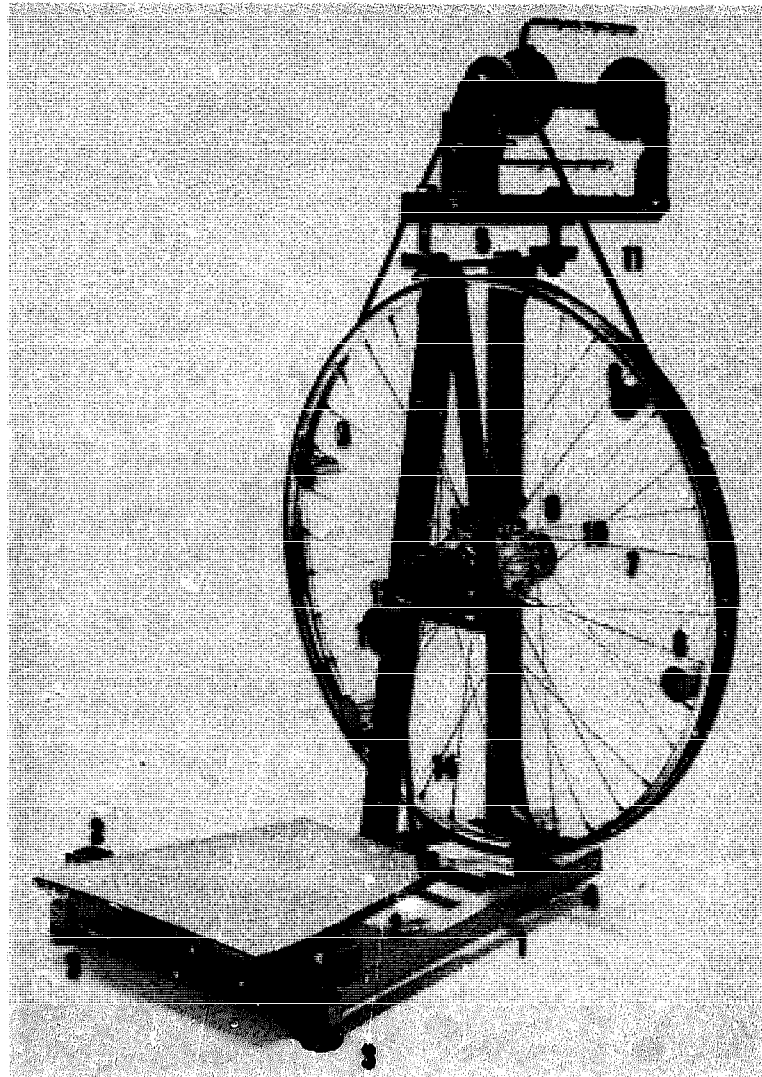
*Medleri Charkha*



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**Figure 2.1 – Frame of the Medleri Charkha**

# 2 Parts of the Medleri Charkha

The Medleri Charkha consists of a *frame with driving wheel, foot pedal and transmission* (figure 2.1) to which either a *medium yarn spinning mechanism* (figure 2.2) or a *fine yarn spinning mechanism* (figure 2.3) can be attached.

## 2.1 Frame and driving-mechanism

The *frame* consist of the following parts (figure 2.1):

- 1 a *ground frame with three supports*,
- 2 *two pedal hinges with pieces of leather mounted inside to facilitate the movement of the foot pedal*,
- 3 *two front legs*,
- 4 *one rear leg*,
- 5 a *cross beam with two holes inside for the attachment of one of the spinning mechanisms*.

The *driving wheel* consists of the following parts (figure 2.1):

- 7 a *bicycle wheel with rubber rim tape mounted around the rim to prevent the leather driving belt from wearing*,
- 8 *several weights creating a spinning-facilitating fly-wheel effect*,
- 9 a *shaft mounted in the hub of the bicycle wheel*,
- 10 *two ball bearings with supports*,
- 11 a *leather driving belt*.

The *foot pedal and transmission* consist of the following parts (figure 2.1):

- 12 a *crank mounted on the shaft of the driving wheel*,
- 13 a *cross-head with a nylon bush inside (water pump spare part) and mounted on the crank with leather washers at both sides*,
- 14 a *connecting rod (made of a sewing machine spare part)*,
- 15 a *flexible joint between the foot pedal and the connecting rod*,

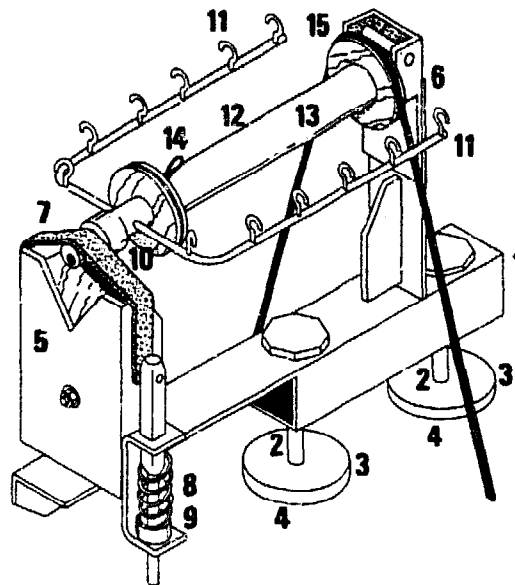
- 16 a *pedal frame* with wooden cover and at both sides two small iron rods.

## 2.2 The medium yarn spinning mechanism

The main components of a *medium yarn spinning mechanism* are a *base* with the *brake mechanism*, a *flyer* and a *bobbin*.

The *base* consists of the following parts (figure 2.2):

- 1 a *main support*,
- 2 *two thread ends*,
- 3 *two adjustment nuts* which rest on the *cross beam* when the *spinning-mechanism* is attached to the *frame*,
- 4 *two counter nuts* used in securing the *mechanism* to the *frame*,
- 5 a *front flyer support* with a piece of wood as bearing for the *orifice*,
- 6 a *rear flyer support* with a piece of leather as bearing for the *spindle*.



**Figure 2.2 – Medium yarn spinning-mechanism**

The *brake mechanism* consists of the following parts (figure 2.2):

- 7 a piece of leather attached to the *front flyer support* and running over the *orifice* to the tension regulator,
- 8 a *spring*,
- 9 a *regulator nut* to regulate the winding speed of the *flyer*.

The *flyer* consists of the following parts (figure 2.2):

- 10 an *orifice*,
- 11 two *flyer arms* with six *hooks* each,
- 12 a *spindle* (inside the *bobbin*),

The *bobbin* consists of the following parts (figure 2.2):

- 13 a *stem* around which the spun yarn is wound,
- 14 a small loop of artificial silk yarn to which a piece of cotton yarn can be tied to start spinning,
- 15 two small *pulleys* with a groove in which the *driving belt* runs to drive the *spinning-mechanism*.

In the *medium yarn spinning mechanism* the *bobbin* is driven with the *driving belt* of the *driving wheel*. The rotation of the *bobbin* is transferred into a rotation of the *flyer* with the help of the newly spun yarn. Because the *flyer* is relatively heavy compared to the *bobbin*, this newly spun yarn needs to have a certain strength to be able to transfer this rotation. So, very fine or loose yarn will easily break by starting spinning.

Since the driving point of this spinning mechanism (the *pulley* of the

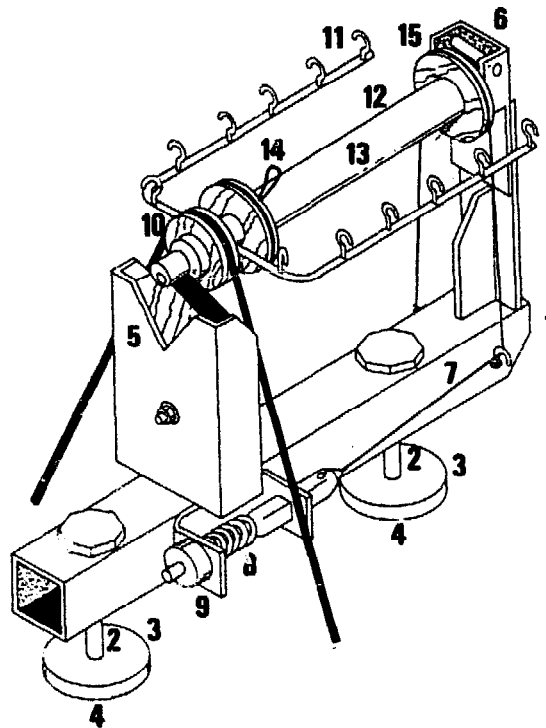


Figure 2.3 – Fine yarn spinning-mechanism

*bobbin*) is close to the rear flyer support of the 6mm diameter *spindle* only little friction is generated when the mechanism is driven. Because of this the *medium yarn spinning mechanism* is very suitable to spin yarn of medium thickness (up to 4 or 5 count).

## 2.3 The fine yarn spinning mechanism

The main components of a *fine yarn spinning mechanism* are a base with *brake mechanism*, a *flyer* and a *bobbin*.

The *base* consists of the following parts (figure 2.3):

- 1 a main *support*,
- 2 two *thread ends*,
- 3 two *adjustment nuts* which rest on the *cross beam* when the *mechanism* is attached to the *frame*,
- 4 two *counter nuts* used to secure the *mechanism* to the *frame*,
- 5 a *front flyer support* with a piece of wood as bearing for the *orifice*,
- 6 a *rear flyer support* with a piece of leather as bearing for the *spindle*.

The *brake mechanism* consists of the following parts (figure 2.3):

- 7 a piece of artificial silk yarn attached to the main *support* and running over the pulley of the *bobbin* along the hook on the main support to the tension regulator,
- 8 a *spring* with washer,
- 9 a *regulator nut* to regulate the winding speed of the *bobbin*.

The *flyer* consists of the following parts (figure 2.3):

- 10 an *orifice* and a *pulley* with a groove in which the *driving belt* runs to drive the *spinning mechanism*,
- 11 two *flyer arms* with six *hooks* each,
- 12 a *spindle* (inside the *bobbin*).

The *bobbin* consists of the following parts (figure 2.3):

- 13 a *stem* around which the spun yarn is wound,
- 14 a small loop of artificial silk yarn to which a piece of cotton yarn can be tied to start the spinning,
- 15 two large *pulleys* with a small groove in which the piece of artificial silk yarn of the *brake mechanism* is running.

In the *fine yarn spinning mechanism* the *flyer* is driven with the *driving belt* of the *driving wheel*. The rotation of the *flyer* is transferred into a rotation of the *bobbin* with the help of the newly spun

yarn. Because the *bobbin* is relatively light compared to the *flyer* this newly spun yarn needs to have only little strength to be able to transfer this rotation.

Since the driving point of this spinning mechanism (the *pulley* of the *orifice*) is close to the front flyer support of the 16mm diameter *orifice* some friction is generated when the mechanism is driven.

Because of this the *fine yarn spinning mechanism* is very suitable to spin fine yarn (up to 6 or 7 count), but it is somewhat heavier to operate than a *charkha* with the *medium yarn spinning mechanism*.

## 2.4 The rewind spindle (accessory)

The *rewind spindle* is an accessory which can be used to rewind the spun yarn from the *bobbin* into a cone of yarn (*kukedi*).

It fits on a *medium yarn spinning mechanism* as well as on a *fine yarn spinning mechanism*. When used, the *flyer* and the *bobbin* are removed from the *mechanism* and the *rewind spindle* is placed in their position in the set.

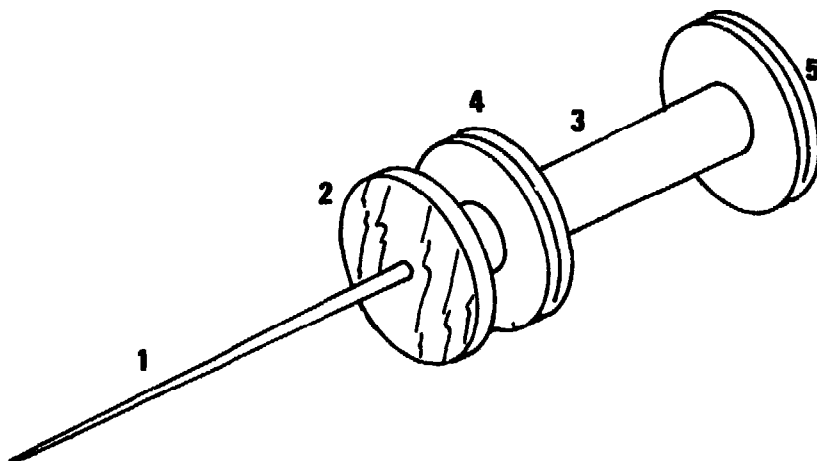


Figure 2.4 – Rewind spindle

The *rewind spindle* consists of the following parts (figure 2.4):

- 1 a spindle,
- 2 a wooden disk with a small hole,
- 3 a body (iron and PVC),
- 4 a front pulley near the iron part of the body,
- 5 a rear pulley at the end of the PVC part of the body.

When used on a *medium yarn spinning mechanism* the *rewind*

*spindle* is driven by the *driving belt* which is positioned over the *rear pulley*.

When used on a *fine yarn spinning mechanism* the *rewind spindle* is driven by the *driving belt* which is then positioned over the *front pulley*.



# **3 General instructions for use and maintenance**

## **3.1 Carrying the Medleri Charkha**

*Never carry the charkha by holding the wheel or the flyer mechanism!*

Hold it by the ground frame, the legs or the main support of the flyer mechanism.

## **3.2 Installation of the Medleri Charkha**

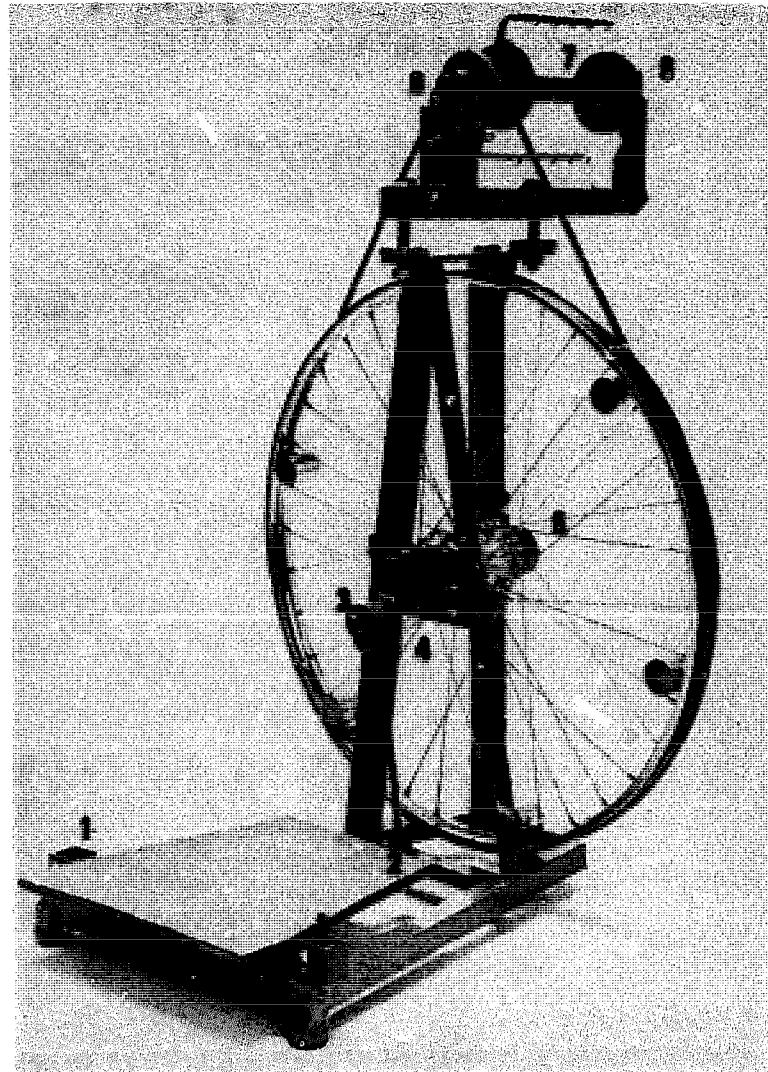
The Medleri Charkha must be placed in an upright position with only the three *supports* of the *ground frame* resting on the floor. Take care that the *driving wheel* can rotate without touching any objects.

## **3.3 Daily maintenance**

Each day before starting spinning, the Medleri Charkha needs to be cleaned and after cleaning some parts need a small drop of oil.

- Remove the *driving belt*, *flyer* and *bobbin* from the *spinning-mechanism* and keep the *flyer* and the *bobbin* under the chair to prevent people from stumbling over them.
- First clean the Medleri Charkha totally with cotton waste.
- After this clean the following points of the charkha with a little brush (for instance, a tooth brush) in this sequence (figure 3.1):
  - 1 the leather pieces inside the *pedal hinges*,
  - 2 the *flexible joint* between the *foot pedal* and the *connecting rod*,
  - 3 the joint between the *connecting rod* and the *cross-head*,
  - 4 the leather washers at both sides of the *cross-head*,
  - 5 the two *ball bearings*,

- 6 the piece of leather in the *rear flyer support* and the piece of wood in the *front flyer support* of the *spinning mechanism*,
- 7 the *spindle* inside the *bobbin*.



*Figure 3.1 – Cleaning the Medleri Charkha*

- Oil the above mentioned points (except the ball bearings!) after cleaning with only *one* small drop of oil – not more!

***Never use grease on the moving parts, because dirt will stick to it!***

- Mount, after cleaning and oiling the *flyer*, the *bobbin* and the *driving belt* again on the *spinning mechanism*. See paragraphs 4.1 to 4.3.

### 3.4 Storage of the charkha

- Remove the *driving belt* from the *driving wheel* and *flyer mechanism*.
- Wrap the belt around the front legs of the charkha to prevent people from stumbling over it.
- Release the tension from the *brake mechanism* with the *regulator nut* to prevent the *brake mechanism* from stretching.
- Clean the charkha carefully.
- Put a piece of cloth over the charkha to protect it from dust.
- Store the charkha in a safe and dry place.

### 3.5 Mounting a new driving belt

The *driving belt* used in the Medleri Charkha is the same belt as used in foot-operated sewing-machines and can be bought in any shop selling sewing-machine spare parts.

There are two ways to join the two ends of a leather belt together. One way is to join the belt with a staple. A second way is to join the belt with a piece of artificial silk yarn.

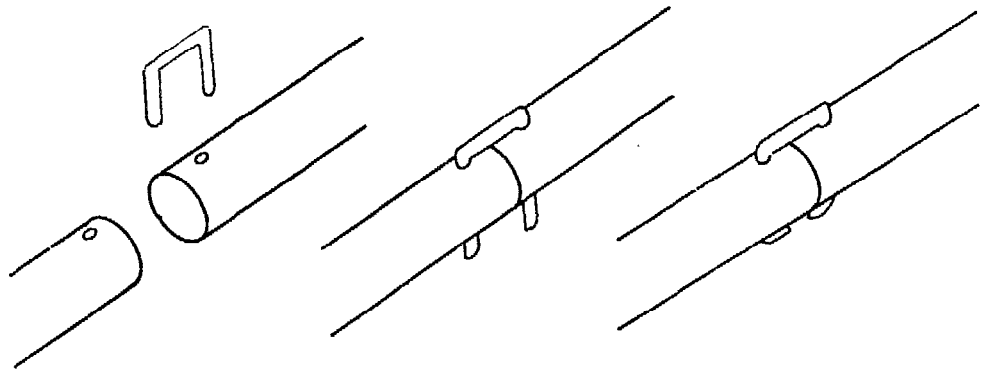
The *spinning mechanism* should be positioned half-way between the lowest and the highest position of the set, before mounting a new *driving belt* to be able to reduce or increase the tension of the belt after mounting.

#### Joining the driving belt with a staple

Refer to figure 3.2. If a pair of combination pliers is available, the easiest way to join the *driving belt* is to use a staple.

- Position the *spinning mechanism* in a position halfway between the lowest and highest position.
- Mount the *flyer* and the *bobbin* on the *spinning mechanism*.
- For a *medium yarn spinning mechanism*:
  - Cut the belt in such a way that both ends of the belt just touch when the belt is fitted without any twists around the *driving wheel* and the *pulley* of the *bobbin* near the *rear flyer support*.
- For a *fine yarn spinning mechanism*:
  - Cut the belt in such a way that both ends of the belt just touch when the belt is fitted without any twists around the *driving wheel* and the *pulley* of the *orifice* near the *front flyer support*.
- Make in the middle of both ends of the belt a small hole, using a nail.

- Mount the belt on the charkha and join the ends with the staple by using the pair of combination pliers.

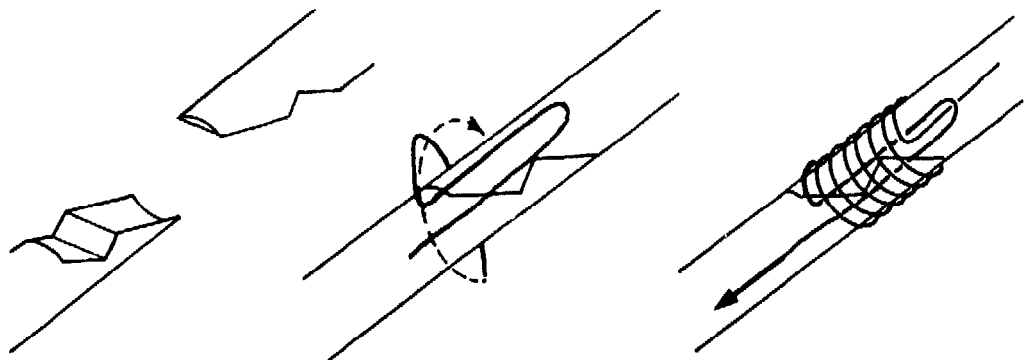


**Figure 3.2 – Joining the driving-belt with a staple**

### **Joining the driving belt with a piece of artificial silk yarn**

When no pair of combination pliers is available the *driving belt* can also be joined with a piece of artificial silk yarn (figure 3.3).

- Position the *spinning mechanism* in a position halfway between the lowest and highest position.
- Mount the *flyer* and the *bobbin* on the *spinning mechanism*.
- For a *medium yarn spinning mechanism*:
  - Cut the belt in such a way that both ends of the belt overlap for 35mm (1.5 inches) when the belt is fitted without any twists around the *driving wheel* and the *pulley* of the *bobbin* near the *rear flyer support*.



**Figure 3.3 – Joining the driving-belt with a silk yarn**

- For a *fine yarn spinning mechanism*:
  - Cut the belt in such a way that both ends of the belt overlap for 35mm (1.5 inches) when the belt is fitted without any twists around the *driving wheel* and the *pulley* of the *orifice* near the *front flyer support*.

- Taper the overlapping ends of the belt and make two small incisions in these ends as shown in figure 3.3.
- Mount the belt on the charkha and join both ends of the belt in such a way that the tapered ends overlap each other.
- Lay a non-twisted loop of artificial silk yarn over the overlapping ends of the belt and hold the short end of the loop with a finger.
- Tightly wind the long end of the yarn around the overlapping ends of the belt and the loop, starting with a few windings in the incision closest to the end hold with a finger and ending with a few windings in the incision closest to the loop.
- Put the end of the long piece of yarn through the loop and carefully pull the short end of the yarn until the loop of yarn is under the windings.
- Burn both ends of the yarn to prevent them from fraying.

# 4 Use of the spinning mechanisms

## 4.1 Mounting the spinning mechanism

- Remove the *flyer* and the *bobbin* from the *spinning mechanism* and keep them under the chair to prevent people from stumbling over them.
- Remove the *counter nuts* from the *thread ends*, but keep them available.
- Put both *adjustment nuts* in a position close to the main support of the base of the *spinning mechanism*.
- Insert the *thread ends* in the two holes of the *cross beam* of the *frame*. Take care that the *front flyer support* with the wooden bearing is facing towards the *foot pedal*.
- Mount the *counter nuts* on both *thread ends* underneath the *cross beam*, but do not secure the nuts yet.
- Mount the *flyer*, the *bobbin* and the *driving belt* on the *spinning mechanism*.
- Adjust the position of the *spinning mechanism* with the *adjustment nuts* until the tension in the *driving belt* is such that the belt just does not slip over the *pulley* of the *bobbin*.

***Take care that both adjustment nuts are adjusted at the same distance to keep the main support of the spinning mechanism parallel to the cross beam of the frame.***

- Turn on the *counter nuts* until they touch the *cross beam*.
- Now secure the *spinning mechanism* by turning the *adjustment nuts* tightly.

## 4.2 Removal of the spinning mechanism from the frame

Remove the *driving belt*, the *flyer* and the *bobbin* from the *spinning mechanism* and keep the *flyer* and the *bobbin* under the chair to prevent people from stumbling over them.

- Loosen the *spinning mechanism* by releasing the *adjustment nuts*.
- Remove the *counter nuts* from the *thread ends* and keep them ready.
- Lift the *spinning mechanism* from the *cross beam* of the charkha.
- Mount the *counter nuts* again on the *thread ends* to prevent them from getting lost.
- Mount the *flyer* and the *bobbin* on the *spinning mechanism* and keep the complete set in a safe place until it will be used again.

## 4.3 Mounting the bobbin

- Insert the *spindle* without force into the hole of the *bobbin*.
- Rotate and align the *bobbin* carefully on the *spindle* until it fits.

## 4.4 Mounting the flyer

- Release the tension in the *brake mechanism* with the *regulator nut*.
- For a *medium yarn spinning mechanism*:
  - Hang the *driving belt* over the main *support* of the *spinning mechanism* behind the *rear flyer support*.
  - Place the end of the *spindle* on the piece of leather under the bolt of the *rear flyer support*. Take care that the end of the *spindle* is not placed on top of the bolt.
  - Bend the piece of leather of the *brake mechanism* slightly forward and place the *orifice* on the *front flyer support*.
  - Put the piece of leather of the *brake mechanism* over the *orifice*.
- For a *fine yarn spinning mechanism*:
  - Hang the piece of artificial silk yarn of the *brake mechanism* over the *rear flyer support*.
  - Place the *orifice* with the *pulley* on the *front flyer support*.
  - Fit the piece of artificial silk yarn in the small groove of the pulley of the *bobbin* closest to the *rear flyer support* and guide the yarn along the *hook* on the main *support* of the *spinning mechanism*.

## 4.5 Mounting the driving belt

- Place the *driving belt* first in the groove of the *pulley* of the *bobbin* closest to the *rear flyer support* (*medium yarn spinning mechanism*) or in the groove of the pulley on the *orifice* (*fine yarn spinning mechanism*).
- Guide the belt with the right hand down along the rim of the *driving wheel* until the bottom.
- Hold with your left hand the belt, coming from your right, inside the rim and rotate the *driving wheel* clockwise until the belt jumps totally inside the rim.
- Take care that the belt does not jump off the *pulley*. If it jumps off, first remove the belt from the rim and start again.

## 4.6 Adjusting the tension of the driving belt

Due to changes in weather conditions or wear of the *driving belt* the tension in the *driving belt* might change.

If the belt is too loose it will slip over the pulley and this will lead to irregular spinning. If the belt is too tight, spinning becomes very heavy. The tension of the *driving belt* is proper when the belt just does not slip over the pulley. Several tries in adjusting the tension might be needed before the proper tension is set.

### Increasing the tension of driving belt

- Mount the *flyer*, the *bobbin* and the *driving belt* on the *spinning mechanism*.
- Loosen the *spinning mechanism* by releasing the *adjustment nuts*.
- Turn the *counter nuts* loose on the *thread ends* for some distance, but do not remove them completely.
- Raise the *spinning mechanism* with the *adjustment nuts* until the tension in the *driving belt* is such that the belt just does not slip over the *pulley* of the *bobbin*.
- Turn on the *counter nuts* until they touch the *cross beam*.
- Now secure the *spinning mechanism* by turning on the *adjustment nuts* tightly.

If in the highest position of the *spinning mechanism* (*counter nuts* at the outmost end of the *thread ends*) the *driving belt* is still too loose, the belt is too long. Mount the belt again following the instructions for



mounting a new *driving belt* or mount a new *driving belt* when the belt is worn out too much.

### **Decreasing the tension of the driving belt**

- Mount the *flyer*, the *bobbin* and the *driving belt* on the *spinning mechanism*.
- Loosen the *spinning mechanism* by releasing the *adjustment nuts*.
- Lower the *spinning mechanism* with the *adjustment nuts* until the tension in the *driving belt* is such that the belt just does not slip over the *pulley*.
- Turn on the *counter nuts* until they touch the *cross beam*.
- Now secure the *spinning mechanism* by turning on the *adjustment nuts* tightly.

If in the lowest position of the *flyer mechanism* (*adjustment nuts* touch the main support of the *flyer mechanism*) the *driving belt* is still too tight, the belt is too short and a new belt needs to be mounted following the instructions for mounting a new *driving belt*.

## **4.7 Adjusting the winding speed**

In the *medium yarn spinning mechanism* the winding speed is regulated by the *brake mechanism*. The *bobbin* is driven with the *driving belt* of the *driving wheel*. The rotation of the *bobbin* is transferred into a rotation of the *flyer* with the help of the newly spun yarn. Winding of yarn around the *bobbin* takes place because the rotation of the *flyer* is broken with the piece of leather of the *brake mechanism* running over the *orifice*. During spinning the *bobbin* fills up with yarn and this also influences the winding speed.

In the *fine yarn spinning mechanism* the winding speed is regulated by the *brake mechanism*. The *flyer* is driven by the *driving belt* and the *driving wheel*. The rotation of the *flyer* is transferred into a rotation of the *bobbin* with the help of the newly spun yarn.

Winding of yarn around the *bobbin* takes place because the rotation of the *bobbin* is broken with the piece of artificial silk yarn of the *brake mechanism* running over the rear pulley of the *bobbin*. During spinning the *bobbin* fills up with yarn and this also influences the winding speed.

By adjusting the tension of the *brake mechanism* with the *regulator nut* the winding speed can be regulated to get a proper speed.

### **Increasing the winding speed**

- Increase the tension of the *brake mechanism* by turning on the *regulator nut* in small steps.
- Check the winding speed and adjust again if necessary.

If the winding speed does not increase even when the *regulator nut* is completely tightened, the piece of leather is too long and should be replaced by a shorter piece (*medium yarn spinning mechanism*) or the piece of artificial silk yarn is too long and should be replaced by a shorter piece (*fine yarn spinning mechanism*).

### **Decreasing the winding speed**

- Decrease the tension of the *brake mechanism* by unscrewing the *regulator nut* in small steps.
- Check the winding speed and adjust again if necessary.

If the winding speed does not decrease even when the *regulator nut* is completely loosened, the piece of leather is too short and should be replaced by a longer piece (*medium yarn spinning mechanism*) or the piece of artificial silk yarn is too short and should be replaced by a longer piece (*fine yarn spinning mechanism*).

## **4.8 Removal of the driving belt**

- Place the right hand between the *driving belt* and the rim of the *driving wheel*.
- Push the *driving belt* a little outside the rim and rotate the *driving wheel* clockwise. The belt will jump of the wheel.
- Take the *driving belt* from the *pulley* and hang it over the main support of the *spinning mechanism* behind the *rear flyer support* (*medium yarn spinning mechanism*) or in front of the *front flyer support* (*fine yarn spinning mechanism*).
- If the charkha is not going to be used for some time, wrap the *driving belt* around the front legs to prevent people from stumbling over it.

## 4.9 Removal of the flyer

- Remove the *driving belt* from the *driving wheel* and *spinning mechanism* and hang it over the main support of the *spinning mechanism*.
- Release the tension in the *brake mechanism* with the *regulator nut*.
- For a *medium yarn spinning mechanism*:
  - Bend the piece of leather of the *brake mechanism* slightly forward and lift the *orifice* off the *front flyer support*.
  - Take the end of the *spindle* out of the piece of leather under the bolt of the *rear flyer support*.
- For a *fine yarn spinning mechanism*:
  - Take the piece of artificial silk yarn out of the small groove of the pulley of the *bobbin* and hang it over the *rear flyer support*.
  - Lift the *orifice* off the *front flyer support*.

## 4.10 Mounting the rewind spindle (accessory)

- Release the tension in the *brake mechanism* completely with the *regulator nut*.
- Remove the *driving belt*, the *flyer* and the *bobbin* from the *spinning mechanism* and keep the *flyer* and the *bobbin* under the chair to prevent people from stumbling over them.
- Hang the *driving belt* over the main support of the *spinning mechanism*.
- Remove the wooden disk from the *rewind spindle*.
- For a *medium yarn spinning mechanism* (figure 4.1):
  - Insert the *spindle* from rear to front under the piece of leather of the *brake mechanism* on top of the *front flyer support*.
  - Place the thin part of the *spindle body* on top of the *front flyer*

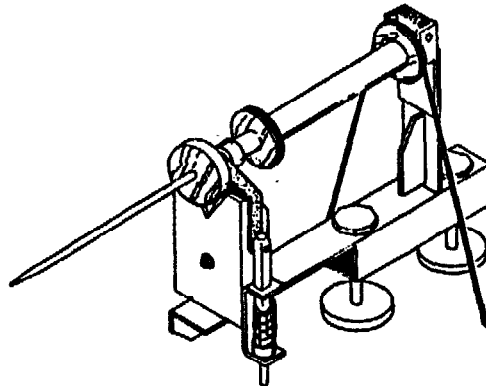
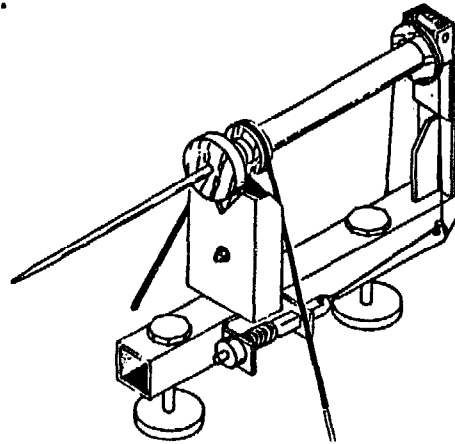


Figure 4.1 – Rewind spindle on a  
medium yarn spinning mechanism

*support* and put the piece of leather of the *brake mechanism* over this part. Do not tighten the *brake mechanism*.

- Lift the *spindle body* until the thicker part of the body can be pulled forward over the *front flyer support* and until the rear *spindle end* can pass the bolt of the rear *flyer support*.
  - Insert the rear *spindle end* on the piece of leather under the bolt of the rear *flyer support*.
  - Place the thin part of the *spindle body* on top of the *front flyer support* and tighten the *brake mechanism* a little to prevent the *spindle* from jumping off the *front flyer support*. Take care that the rotation of the *spindle* is not broken.
- For a *fine yarn spinning mechanism* (figure 4.2):
- Place the *spindle end* on the piece of leather under the bolt of the rear *flyer support*. Take care that the *spindle end* is not placed on top of the bolt.
  - Place the thin iron part of the *spindle body* on top of the *front flyer support*.



**Figure 4.2 – Rewind spindle on a fine yarn spinning-mechanism**

- Put a small piece of wood under the bolt of the rear *flyer support* on top of the *spindle end* to prevent the *spindle end* from jumping inside the rear *flyer support*.
- Mount the wooden disk on the *spindle* to the *spindle body* in front of the *front flyer support*.
- Mount the *driving belt* over the *pulley* and the *driving wheel*.

#### **4.11 Removal of the the rewind spindle (accessory)**

- Remove the *driving belt* and hang it over the main *support* of the *spinning mechanism*.

- Release the tension in the *brake mechanism* completely by turning the *regulator nut*.
- Remove the wooden disk from the *spindle*.
- For a *medium yarn spinning mechanism*:
  - Lift the *spindle body* until the thicker part of the body can be pulled forward over the *front flyer support*. Pull the *spindle* forward over the *support* until the *rear spindle end* can pass the bolt of the *rear flyer support*.
  - Remove the *rear spindle end* from the *rear flyer support*.
  - Remove the *spindle* from under the piece of leather of the *brake mechanism* on top of the *front flyer support*.
- For a *fine yarn spinning mechanism*:
  - Remove the small piece of wood from the *rear flyer support*.
  - Lift the iron part of the *spindle body* off the *front flyer bearing*.
  - Take the *spindle end* from the piece of leather under the bolt of the *rear flyer support*.
- Mount the wooden disk again on the *spindle* and keep the *rewind spindle* in a safe place until it will be used again.
- Mount the *flyer*, the *bobbin* and the *driving belt* on the *spinning mechanism*.

# 5 Instructions for spinning

## 5.1 Positions

### Type and height of a chair

Because spinning takes many hours, a chair with back and elbow rests is preferable. The height of a chair is right for spinning when, with your feet placed on the *foot pedal* of the charkha, the angle

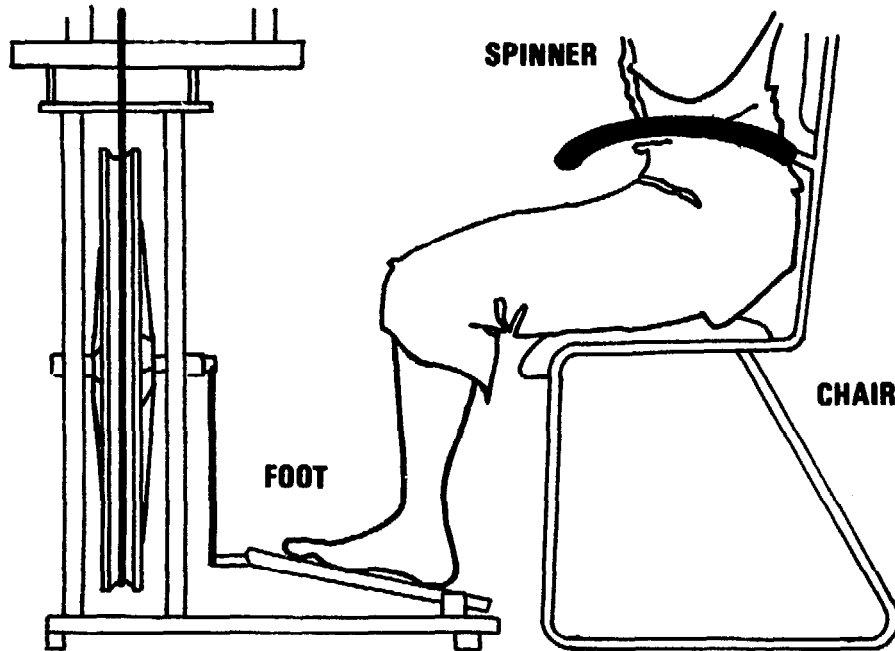


Figure 5.1 – Position

between back and upper legs and the angle between upper legs and lower legs both are more or less square (figure 5.1). Check, before starting to practise treading or spinning, the height of the chair. Raise either the chair or the charkha when the height is not correct.

### Position of the charkha in front of a chair

The charkha should be placed close enough to the chair that the

angle between back and upper legs and the angle between upper legs and lower legs both are more or less square (figure 5.1).

### **Sitting position**

Sit relaxed with your arms on the elbow rests of a chair and with your back against the back of the chair.

### **Position of the feet on the foot pedal of the charkha**

Your feet should be placed next to each other on the *foot pedal* in such a way that the ankles of your feet are between the *pedal hinges* (figure 5.1).

During treading your toes should not be lifted from the *foot pedal* and your upper legs should not move up and down. Your ankles should act as hinges during treading.

## **5.2 Instructions for treading**

- Position the charkha in front of the chair.
- Mount the *flyer*, the *bobbin* and the *driving belt* on the *spinning mechanism*.
- Sit relaxed with your arms on the elbow rests of the chair and with your back against the back of the chair.
- Place your feet next to each other on the *foot pedal*.
- Turn the *driving wheel* with your right hand to the right, clockwise from your position. The front side of the *foot pedal* will rise when the *driving wheel* is turned.
- Continue turning the *driving wheel* clockwise until the *foot pedal* reaches its highest point and starts to go down again.
- Push the *foot pedal* down as soon as it starts to go down after reaching its highest point. By pushing, the rotation speed of the *driving wheel* will increase and the wheel will continue rotating.
- Stop pushing down the *foot pedal* as soon as the pedal reaches its lowest point and let the pedal rise again to its highest point.
- Push the *foot pedal* down again with your feet as soon as the pedal starts to go down again after reaching its highest point.
- Remain treading in this way and look at the *driving wheel* to check if the rotation direction is clockwise.

- Treadle continuously but not too fast. Don't look at your feet. Try to treadle without thinking about it!
- Practise treadling in this way for several days, a few hours a day, until treadling is done without thinking about it.

***Do not treadle for too long at one time in the beginning. Your muscles need to get adjusted to its new movement. It is better to practise several times for a short period a day.***

- After practising treadling or spinning remove the *driving belt* from the *spinning mechanism* and the *driving wheel* and wrap the belt around the front legs of the charkha to prevent people from stumbling over it. Release the *brake mechanism* to prevent it from stretching.

### **5.3 Spinning instructions**

#### **Using a new bobbin for the first time**

- Tie a piece of cotton yarn of approximately 1 metre (3 feet) to the small loop of artificial silk yarn of the *bobbin*. This is needed as a starting point for spinning.
- Unravel the end of the piece of cotton yarn a little to ease spinning the twisting end of the cotton yarn together with fibres.
- The piece of cotton yarn remains as a starting point tied to the *bobbin* after rewinding the spun yarn from it.

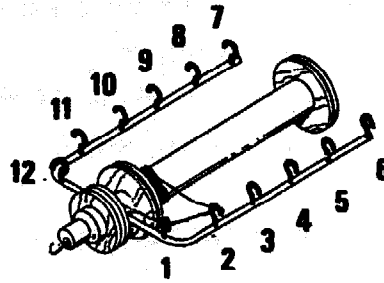
#### **Guiding yarn along the flyer arms and through the orifice**

Refer to figure 5.2. On the *flyer arms* twelve *hooks* are mounted to guide the spun yarn smoothly from the *orifice* along the arms to the *bobbin*, where it is stored. The purpose of hooks 1 and 12 is to guide the yarn around the corners of the arms to prevent the yarn from touching the pulley of the *bobbin*.

Fix the yarn properly in the following way to start spinning:

- Guide the end of the cotton yarn (when the *bobbin* is still empty) or the end of the spun yarn from the *bobbin* along the hooks of one *flyer arm* to the hole of the *orifice*.
- Pull the end of the yarn through the hole of the *orifice* from rear to

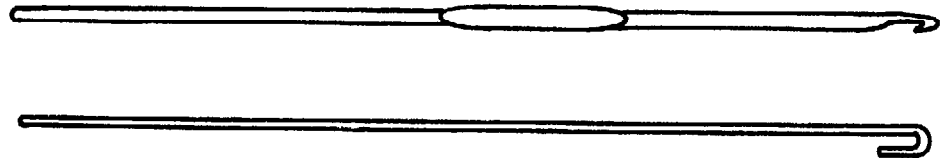




**Figure 5.2 – Hooks on the bobbin**

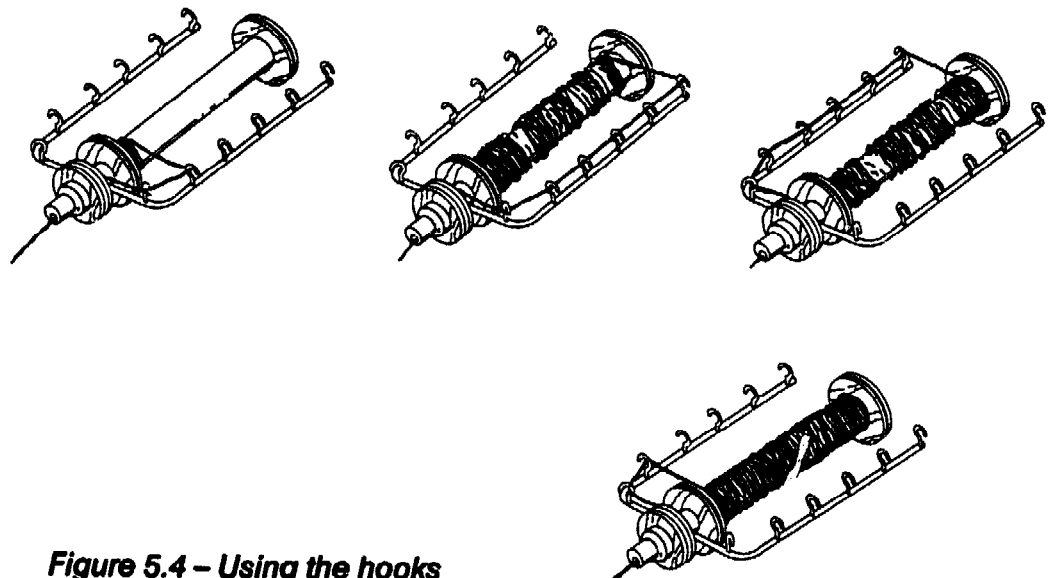
front with the help of a crochet hook or a hook made out of a piece of iron wire (figure 5.3).

**Using the hooks on the flyer arms during spinning**



**Figure 5.3 – Crochet hook and iron wire**

Refer to figure 5.4. The twelve hooks on the arms of the *flyer* are placed at regular intervals to make it possible, by changing the spun yarn every now and then to the next hook, to wind spun yarn evenly around a *bobbin*. Use the hooks in the following way when starting with an empty *bobbin*:



**Figure 5.4 – Using the hooks**

- Guide the piece of cotton yarn along hooks 2 and 1 and through the hole in the *orifice* and start spinning.
- Change the direction of the spun yarn from hook 2 to hook 3 after the yarn is wound about 1 centimetre (a half inch) thick around the *bobbin*.
- Change from hook 3 to hook 4 after the yarn is wound again about 1 centimetre (a half inch) thick around the *bobbin*.
- Change from hook 4 to hook 5 and from hook 5 to hook 6 in the same way.
- After hook 6 the yarn is guided along hook 7 on the other *flyer arm*.
- Take care to change the direction also to hook 12 instead of hook 1 when changing to the other arm.
- Change from hook 7 to 8, 8 to 9, 9 to 10 and 10 to 11 each time the yarn is wound about 1 centimetre (a half inch) thick around the *bobbin*.
- Change after hook 11 again to hook 1 and 2 and repeat changing hooks each time the thickness of the yarn wound around the *bobbin* has increased by 1 centimetre (a half inch).
- Continue filling the *bobbin* regularly in this way until the spun yarn almost starts to touch the *flyer arms*.

#### **5.4 Measuring the count of spun yarn**

Count (metres of spun yarn per gram spun yarn) is a indication of the thickness of the spun yarn. The higher the count the thinner the yarn spun will be. Count is determined by measuring the weight of a certain length (for instance, 20 metre) of spun yarn. After weighing, the count can be calculated by dividing the length of yarn in metres by the measured weight in grammes.

If for example 20 metres of spun yarn weighs 4 grammes the spun yarn has a count of  $20 / 4 = 5$ .

#### **5.5 Making rolags of woollen fibres**

Rolags (chekku's) are rolls of carded woollen fibres. Making rolags of the carded woollen fibres makes spinning the wool easier.

Rolags are made in the following way (figure 5.5):

- Make from tufts of carded woollen fibres a square layer (15 x 15 centimetres or 6 x 6 inches) of regular thickness with the fibres facing the same direction. Do not make it too thick.

- Roll the layer of woollen fibres, in the direction of the fibres, with a little empty space in the middle.

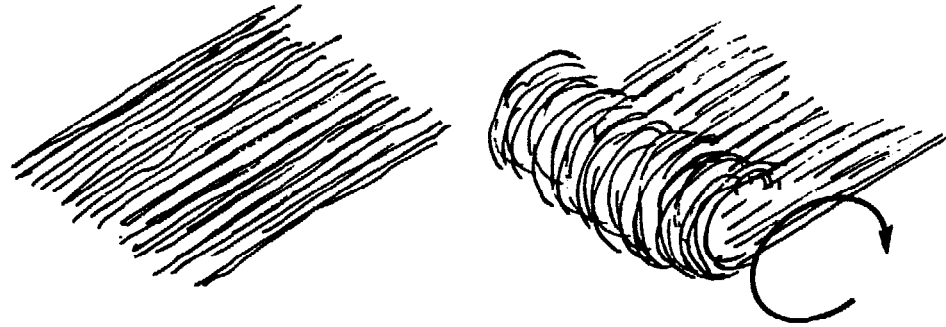


Figure 5.5 - Rolags

- Treat rolags gently until they are used for spinning.

## 5.6 Rewinding spun yarn

When a *bobbin* is filled with spun yarn it might be necessary to rewind the yarn into a cone of yarn. This rewinding can be done with the *rewind spindle* which is available as an accessory, or with the help of a traditional *charkha*.

- Put the *bobbin* filled with spun yarn in a spool rack made from wood or a cardboard box and thin pieces of iron rods which fit inside the bobbins (figure 5.6).
- Place the spool rack at your right hand side.
- Mount the *rewind spindle* and the *driving belt* on the *spinning mechanism*.

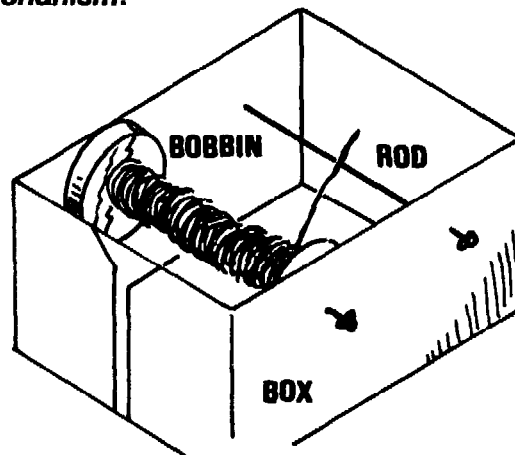


Figure 5.6 - Rewinding spun yarn

- Wind the end of the piece of yarn from the filled *bobbin* a few revolutions around the *rewind spindle* near the wooden disk.
- Hold the yarn coming from the *bobbin* loosely with your left hand and

- start treading by turning the *driving wheel* to the right (clockwise from your position) with your right hand.
- Wind the yarn from the *bobbin* into a cone around the *rewind spindle* using your left hand to guide the yarn and shape the cone.
  - Stop treading when the cone of yarn is large enough and pull the cone from the *rewind spindle*.
  - After rewinding remove the *rewind spindle* from the *spinning mechanism*.
  - Mount the *flyer* and the *bobbin* on the *spinning mechanism*.

When a traditional charkha is used, the end of the spun yarn coming from the *bobbin* in the spool rack (to the left of the spindle) is wound around the spindle of the charkha, so while your right hand is driving the Charkha, your left hand is shaping a cone of yarn around the spindle.

## 5.7 Plying of spun yarn

If a very strong yarn is needed the spun yarn can be plied. Plying is joining two or more yarns together in one thread. Plying is done in the same way as spinning, but with the *driving wheel* turning to the left, anti-clockwise from your position.

- Put the two *bobbins* with the two yarns to be plied in a spool rack made from wood or a cardboard box and thin pieces of iron rods which fits inside the bobbins (figure 5.7).
- Place the spool rack on your left hand side.
- Mount the *flyer*, the *bobbin* and the *driving belt* on the *spinning mechanism*.
- Sit relaxed and tighten the *brake mechanism*.

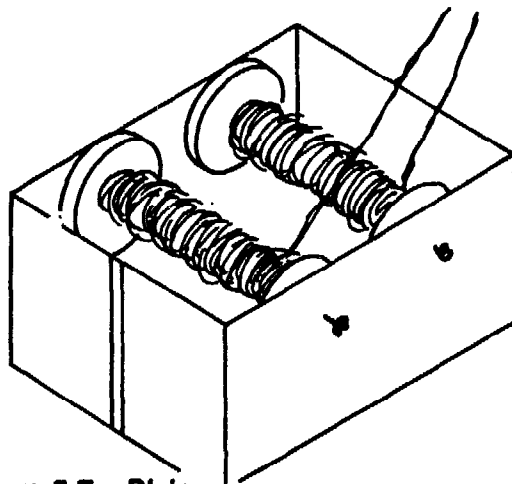
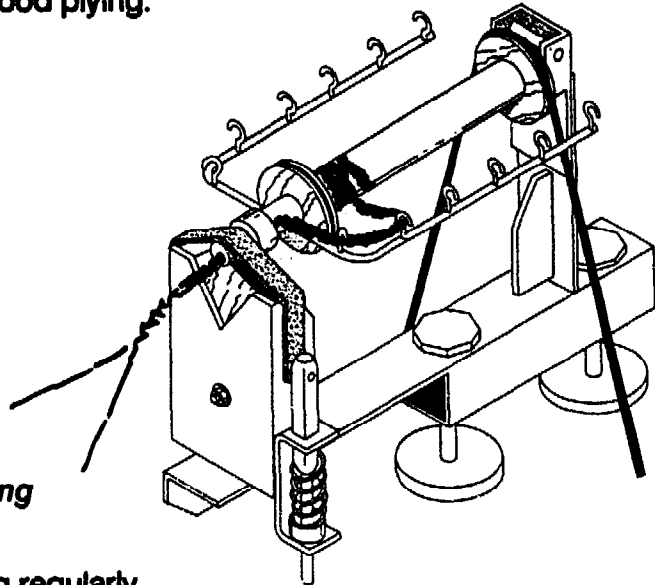


Figure 5.7 – Plying

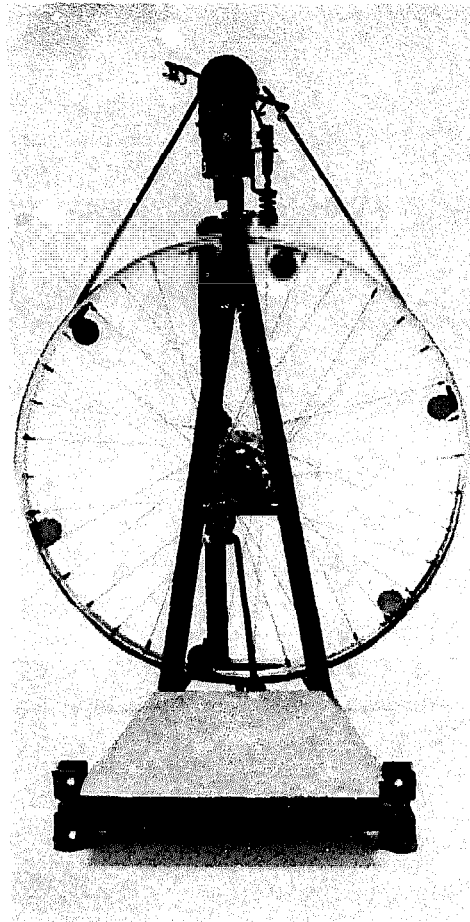
- Guide the piece of cotton yarn along the hooks 1 and 2 on the *flyer arm* and through the hole of the *orifice*.
- Knot the two yarns to be plied to the end of the piece of cotton yarn.
- Hold the two yarns with the index finger of your left hand between them and start treading by turning the *driving wheel* to the left (anti-clockwise from your position) with your right hand. Treadle continuously, but faster than during spinning.
- Hold the already plied yarns tightly with your right hand near the *orifice*.
- Stretch the two yarns by moving your left hand backwards, keeping the index finger between the two yarns to get a regular plying of the threads.
- Release the grip of your right hand and move your left hand slowly towards the *orifice*, guiding the plying yarns with your right hand.
- Take care to move your left hand in a proper speed towards the *orifice* to get a good plying.



**Figure 5.8 – Plying**

- Check the plying regularly.
- Continue plying by stretching the two yarns between your hands and allow the plying to develop in the two yarns.
- Adjust, if needed, the winding speed with the *brake mechanism* during plying.
- Use the hooks on the *flyer arms* during plying as described.

- After plying always remove the *driving belt* from the *flyer mechanism* and wrap it around the front legs of the charkha to prevent people from stumbling over it.
- After plying always release the *brake mechanism* to prevent it from stretching.



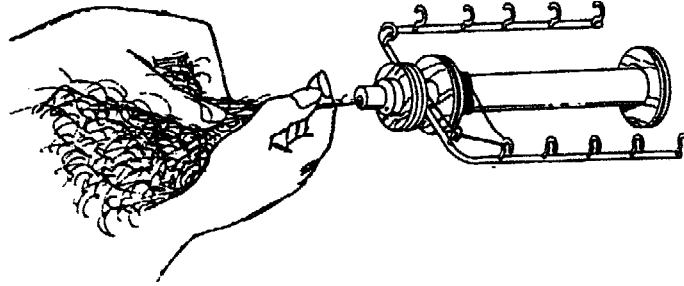
# 6 *Instructions for spinning woollen fibres*

Spinning is the process of twisting woollen fibres into one single yarn. The Medleri Charkha is designed to perform this job in a very convenient way. The charkha can be supplied with a *medium yarn spinning mechanism* for spinning yarn up to count 4 to 5 or with a *fine yarn spinning mechanism* for spinning yarn up to count 6 to 7.

This chapter describes the spinning instructions step by step.

- The daily maintenance instructions must be followed every day before starting to spin.
- Practise, before starting to spin for the first time, treading until you are able to do it without thinking. Follow the instructions for treading.
- Prepare the selected wool by carding and making rolags.
- Mount the *flyer*, the *bobbin* and the *driving belt* on the *spinning mechanism*.
- Sit relaxed and take a rolag of woollen fibres in your left hand.
- Release the *brake mechanism* when spinning is started with an empty *bobbin*.
- Guide the piece of cotton yarn (when spinning is started with an empty *bobbin*) or the end of the spun yarn (when spinning is started with a partly-filled *bobbin*) along the hooks of a *flyer arm* and through the hole of the *orifice*.
- Lay the end of the piece of cotton yarn or the end of the spun yarn between the protruding fibres at the end of the rolag.
- Hold the end of the piece of yarn with the thumb and index finger of your left hand.
- Start treading by turning the *driving wheel* to the right (clockwise from your position) with your right hand. Treadle continuously but not too fast.

- When treadling has started, take the yarn from your left to your right hand.



**Figure 6.1 – Spinning: position of your hands**

- Keep both hands in line with the *orifice* (figure 6.1).
- Hold the wool loosely in your left hand and pull the fibres out of the left hand in the direction of the *orifice* with your right hand. Control the flow of fibres with your left hand.
- While treadling slowly and holding your hands in line with the *orifice*, move your right hand backwards towards your left hand allowing the twist to develop in the fibres just in front of your right hand.

***Take care that the twisting of fibres only takes place in front of your right hand. While moving your right hand backwards towards your left hand, the twisting yarn will slip between the fingers of your right hand, thus aligning the raised fibres.***

- Continue spinning by pulling fibres out of your left hand and moving your right hand backwards towards your left hand to allow the twist to develop in the fibres.
- Stretch the wool as much as possible between your left and right hands if thin yarn of a high count is required. The more the wool is stretched, the thinner the produced yarn will be.
- Adjust, if needed, the winding speed with the *regulator nut* of the *brake mechanism* during spinning as described.
- Use the hooks on the *flyer arms* during spinning as described.
- After spinning always remove the *driving belt* from the *spinning mechanism* and wrap it around the front legs of the charkha to prevent people from stumbling over it.



- After spinning always release the *brake mechanism* to prevent it from stretching.

Note that the fingers of your right hand are very important during spinning, because:

- they prevent the twist of the yarn from developing between your right and left hands,
- they align raised fibres with the yarn thus producing a smoother yarn,
- they can correct a thickening in the spun yarn, by untwisting the thick spot as much as necessary and by stretching it more.

# 7 Operation problems, possible causes and remedies

If a charkha causes problems and tools are needed to overcome these, it might be necessary to ask for the help of a local technician who has the proper tools to solve the problem.

**Problem:** Charkha shakes a lot during spinning.

**Cause 1:** Incorrect charkha position.

**Remedy:** Place the charkha evenly on the three supports of the *frame*.

**Cause 2:** Imbalance in the *driving wheel*.

**Remedy:** Check if a weight is missing in the *driving wheel*. If so, mount the weight again where it was before.

**Problem:** The *driving wheel* does not rotate when the *foot pedal* is operated.

**Cause:** The *shaft* in the hub of the *driving wheel* is not tightly fixed.

**Remedy:** Tighten the nut on the *shaft* at the rear of the hub very well. Hold the *shaft* with an open-ended spanner over the flattened spots in front of the hub or hold it by the crank.

**Problem:** The flexible joint between the *foot pedal* and the *connection rod* makes a lot of noise.

**Cause 1:** Improper position of your feet on the *foot pedal*.

**Remedy:** Place your feet properly on the *foot pedal*.

**Cause 2:** Too much play in the flexible joint.

**Remedy:** Loosen the nut in the bottom of the joint and reduce the play by adjusting the screw in the bottom. Tighten the screw again with the nut. Take care that the *connection rod* still can move freely in the joint.

**Remedy:** If it is not possible to reduce the play by adjusting the screw, the iron ball, nut and screw of the joint are worn out and should be replaced

by new ones, which can be bought in a shop selling sewing-machine spare parts.

**Problem:** The *cross-head* on the *crank* makes a lot of noise.

**Cause:** Too much play in the nylon bush inside the *cross-head*.

**Remedy:** Remove the *cross-head* from the *crank*. Remove the nylon bush from the *cross-head* in which it is press fitted and press fit a new nylon bush in the *cross-head*. A new nylon bush can be bought in a shop selling spare parts for water pumps. Mount the *cross-head* again on the *crank* with a leather washer at both sides of the *cross-head*.

**Problem:** The *driving wheel* rotates but the *flyer* and the *bobbin* are not rotating.

**Cause 1:** The *driving belt* is not mounted correctly.

**Remedy:** Clean the *front* and *rear flyer supports* carefully and mount the *driving belt* as described.

**Cause 2:** The tension of the *driving belt* is too low, causing the belt to slip over the pulley of the *spinning mechanism*.

**Remedy:** Increase the tension of the *driving belt* by raising the *spinning mechanism*, as described.

**Problem:** Treading is easy when no *driving belt* is mounted but very heavy when the *driving belt* is mounted.

**Cause 1:** Dirty *front* and *rear flyer supports*.

**Remedy:** Clean and oil the *flyer supports* carefully, as described.

**Cause 2:** Too much tension in the *driving belt*.

**Remedy:** Decrease the tension in the *driving belt* by lowering the *spinning mechanism* as described.

**Cause 3:** Too much tension in the *brake mechanism*.

**Remedy:** Release the tension in the *brake mechanism* with the *regulator nut*, as described.

**Problem:** The *charkha* is heavy to operate even when no *driving belt* is mounted.

**Cause:** There is a lot of friction in all moving parts.

**Remedy:** Clean the *charkha* carefully, as described in the daily maintenance instructions.

**Problem:** The *spinning mechanism* is winding improperly.

**Cause 1:** Spun yarn is caught on a hook of a *flyer arm*.

**Remedy:** Guide the yarn along the hooks and through the hole in the *orifice*, as described.

**Cause 2:** The wool is wound only around one side of the *bobbin*.

**Remedy:** Use the hooks on the *flyer arms*, as described.

**Cause 3:** There is dirt between the *bobbin* and the *spindle*.

**Remedy:** Remove the *flyer* and the *bobbin* from the charkha and clean the *spindle* and the hole inside the *bobbin*, as described. The *bobbin* should rotate easily around the *spindle*.

**Cause 4:** Improper tension in the *brake mechanism*.

**Remedy:** Adjust the winding speed with the *regulator nut* of the *brake mechanism*, as described.

**Problem:** The *driving belt* jumps of the pulley of the *spinning mechanism*

**Cause:** The main support of the *spinning mechanism* is not parallel to the *cross beam* of the *frame*.

**Remedy:** Mount the *spinning mechanism* parallel, as described.

**Problem:** The *driving belt* jumps off the *driving wheel*.

**Cause:** Improper alignment of the *driving wheel*.

**Remedy:** Have the alignment of the *driving wheel* corrected by an expert. The rim of a properly aligned *driving wheel* is parallel to the front and rear legs of the *frame*. The alignment can be corrected by adjusting the *ball bearings supports* of the *driving wheel*.



*Figure 7.1 – Correct and incorrect twisted yarn*

**Problem:** The yarn has too much twist (figure 7.1).

**Cause 1:** The *bobbin* is full.

**Remedy:** Replace the full *bobbin* by an empty one.

**Cause 2:** You are treading too fast, compared to the pulling speed of your hands.

**Remedy:** Treadle a little bit slower.

**Cause 3:** The yarn is released too slowly from your hands.

**Remedy:** Let the yarn go faster through the *orifice*.

**Cause 4:** Spun yarn is caught on a hook of a *flyer arm*.

**Remedy:** Guide the yarn along the hooks of a *flyer arm* and through the hole in the *orifice*, as described.

**Cause 5:** The winding speed is too low.

**Remedy:** Increase the winding speed with the *regulator nut* of the *brake mechanism*, as described.

**Problem:** The yarn has too little twist (figure 7.1).

**Cause 1:** You are treading too slowly compared with the speed of your hands.

**Remedy:** Treadle a little faster.

**Cause 2:** The yarn is released too fast into the *orifice*.

**Remedy:** Let it go slower through the *orifice*.

**Cause 3:** The winding speed is too high.

**Remedy:** Decrease the winding speed with the *regulator nut* of the *brake mechanism*, as described.

**Problem:** The yarn is too thick (has too low a count).

**Cause:** Insufficient stretching of the wool between your hands.

**Remedy:** Stretch the wool more between your hands to get a higher count.

**Problem:** The yarn breaks often.

**Cause 1:** The *driving wheel* occasionally turns in the wrong direction.

**Remedy:** Practise treading until treading is done without thinking about it.

**Cause 2:** Too little twist, the yarn is not strong enough for winding up.

**Remedy:** Refer to problem: the yarn has too little twist.

**Cause 3:** The yarn pulls in too hard.

**Remedy:** The tension of the *brake mechanism* is too high and must be decreased by turning the *regulator nut*.

**Cause 4:** The rolags are too loose.

**Remedy:** Make the rolags more regularly.

**Cause 5:** The fibres are too short to twist properly.

**Remedy:** Mix the fibres with longer fibres.

**Problem:** Fibres are very difficult to draw out of the wool supply.

**Cause 1:** You hold the wool too tightly in your left hand.

**Remedy:** Hold the wool loosely in your left hand.

**Cause 2:** The twist has come up to the wool in your left hand.

**Remedy:** Take care that the twist does not come behind your right hand.

**Cause 3:** Poor quality of wool.

**Remedy:** Make rolags, as described.

# ***Construction manual***

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# 8 Introduction

Working with villagers from the cluster of villages around Medleri in Karnataka state in India, India Development Service (IDS) came to the conclusion that the existing pre-weaving techniques for wool needed to be improved. Since IDS felt that they lacked the knowledge to improve the presently used pre-weaving techniques, they contacted the TOOL Foundation with the request for appropriate technological assistance.

A TOOL consultant was sent to Medleri. In co-operation with IDS, he made a study of the existing pre-weaving techniques and the occurring problems. The irregular quality of the spun yarn, because of the use of traditional hand-operated spinning wheels, was identified as one of the problems. This problem is caused by the fact that the spinners have only one hand to control the process of twisting the woollen fibres. The other hand is used to drive the spinning wheel.

After a study tour in India, it was decided that the TOOL consultant, together with IDS, would try to improve the quality of the spun yarn by developing and introducing an improved foot-operated spinning-wheel. Using this spinning wheel, the spinners would have more control over the process of twisting the woollen fibres, since they could use both hands.

## **Design and materials**

The first trials were conducted with wooden foot-operated Bhageshwari charkhas. These had been developed in North India. From the trials it was concluded that the quality of the spun yarn improves when a foot-operated spinning wheel is used. The Bhageshwari charkhas, however, were found unsuitable for intensive use in Medleri. They broke down continuously and caused complaints of backaches by the spinners. One of the problems of the Bhageshwari charkha is that its wooden frame is too weak. In comparison with the costs of a wooden frame, the costs of an iron frame were more than acceptable.

A second problem of the Bhageshwari charkha is the fixed, uncomfortable, position of the spinner. The foot pedal is located inside the charkha – between the legs of the frame.

A third major problem of the Bhageshwari charkha is the fact that it has four legs resting on the floor. This causes a lot of shaking of the charkha when it is used on an uneven floor.

Considering the problems that showed up during the trials with the Bhageshwari charkhas, a prototype of a new spinning wheel was constructed. This one was almost completely made of mild steel, with three legs resting on the floor and easy access to the foot pedal, giving the spinner a comfortable position in front of the spinning wheel.

Prolonged trials of this prototype (the Medleri-1 Charkha) in Medleri as well as in The Netherlands resulted in two modified designs which were a lot easier to construct and to operate.

These two modified designs were largely identical, but had a different driving principle. Prolonged trials of these modified designs showed that they were both suitable to spin the wool which is available in Medleri.

In the first modified design (the Medleri-2 Charkha) the bobbin was driven with the leather driving belt of the driving wheel. The rotation of the bobbin was transferred into a rotation of the flyer with the help of the newly spun yarn. Because the flyer is relatively heavy compared to the bobbin, this newly spun yarn needs to have a certain strength to be able to transfer this rotation. So, very fine or loose yarn will easily brake by starting spinning on this design.

Since the driving point of the spinning mechanism of the first modified design, the pulley of the bobbin, is close to the rear flyer support of the 6mm diameter spindle, only a little friction is generated when the mechanism is driven. Because of this, the first modified design was very suitable to spin yarn of medium thickness (up to 4 or 5 count).

In the second modified design (the Medleri-3 Charkha) the flyer was driven with the leather driving belt of the driving wheel. The rotation of the flyer was transferred into a rotation of the bobbin with the help of the newly spun yarn. Because the bobbin is relatively light compared to the flyer this newly spun yarn needs to have only a little strength to be able to transfer this rotation.

Since the driving point of the spinning mechanism of the second modified design, the pulley of the orifice, is close to the front flyer support of the 16mm diameter orifice, some friction is generated when the mechanism is driven. Because of this, the second modified design was very suitable to spin fine yarn (up to 6 or 7 count) although it was heavier to operate than the first modified design.

During the trials of both designs it became clear that changing weather conditions caused expansion or shrinkage of the leather driving belt, thus influencing the tension of the driving belt. To overcome this problem both designs were changed and a mechanism was added to make it possible to adjust the tension of the driving belt.

The result of these changes is a charkha frame for both driving principles, with driving wheel, foot pedal and transmission. On this frame either a medium yarn spinning mechanism or a fine yarn spinning mechanism can be mounted.

The medium yarn spinning mechanism is based on the spinning-mechanism of the first modified design and the fine yarn spinning-mechanism is based on the spinning mechanism of the second modified design.

At the request of spinners using the Medleri Charkhas, a rewind spindle was designed as an accessory for rewinding the spun yarn from a filled bobbin into a cone of yarn (kukedi). This rewind spindle is designed in such a way that it fits in a medium yarn spinning-mechanism as well as in a fine yarn spinning mechanism.

In the next chapters the construction of the charkha frame with driving wheel, foot pedal and transmission, the medium yarn spinning mechanism, the fine yarn spinning mechanism and the rewind spindle are described.

### **Equipment required to construct a Medleri Charkha**

To construct a Medleri Charkha some motor-powered machines and several hand tools are needed. Besides the necessary machines there are some optional machines. These will ease the construction if they are present.

**Necessary motor-powered machines are:**

- Drilling machine with different sized drills
- Lathe with cutting tools
- Welding equipment
- Grinding machine

**Optional motor-powered machines are:**

- Motor-powered metal hack saw
- Milling machine with milling and drilling tools

**Necessary hand tools are:**

- Work bench with a jaw vice
- Scribing and measuring tools
  - Ruler
  - Center punch
  - Drawing point
  - Square
  - Graduated arc
  - Measuring tape
  - Sliding gauge
  - Micrometer gauge
  - Hand hack saw
- Metal files of different sizes
- Taps and dies of different sizes with wrenches
- Hammer
- Cutting knife
- Spanners of different sizes
- A large screwdriver
- Combination pliers
- Several small and large clamps

**Remarks regarding the construction**

If no lathe is available and turning jobs have to be done for a certain component, have this job done in a specialized workshop that can handle the sizes of the component(s). Cutting the materials to the proper size can either be done with a hand hack saw or a motor powered metal hack saw.

In case MS angle iron 25 x 25 x 3 has to be cut into an angle, mark it properly first and then cut it with a hand hack saw. Pieces that do not have to be cut into an angle can be cut with a motor-powered metal

hack saw, if available. Cut a piece 2mm longer than the total length, given in the drawing, if it has to be machined after cutting.

If a number of charkhas are going to be made, it is advisable to construct welding fixtures for specific components, easing the construction of these components and making the charkhas more uniform. In the description of the construction of the different components, the possible use of fixtures is mentioned.

Take care of the following when constructing the Medleri Charkha:

- Clean all welded joints after welding.
- Brake the sharp edges of any drilled hole or any cut piece to prevent people from hurting themselves on sharp spots. Braking of a sharp edge is done stripping of the burrs and chamfering the edge into  $0.5 \times 45^\circ$  by grinding or filing.

### **This manual**

In Chapter 13 a set of construction drawings and in Chapter 14 a components list, a shopping and cutting list are given. In the components list the required materials and lengths of each component's part are given. The numbers in the drawings refer to the numbers in these lists.

In the shopping and sawing list all the components' parts are arranged according to the materials used. The numbers in these lists also refer to the components list. Any extra cutting length needed for machining a certain part is given in the lists. For each material the total required length is given, taken into account the length which is wasted during cutting of the parts.

When purchasing materials take care that the shape is perfect. For instance, MS angle  $25 \times 25 \times 3$  and MS flat  $25 \times 5$  have to be properly straight and must have a uniform shape without twists.

All sizes of material types are given in Metric measurements, which might not be commonly used. Instead of the given sizes in Metric measurements the following sizes in Imperial measurements can be chosen:

For MS angle 25 x 25 x 3 can be chosen	MS angle	1" x 1" x 1/8"
MS flat 25 x 5	MS flat	1" x 3/16" or 1" x 1/4"
idem 25 x 3	idem	1" x 1/8"
idem 20 x 3	idem	3/4 x 1/8"
MS round ø 6	MS round	ø 1/4"
idem ø 10	idem	ø 3/8"
idem ø 16	idem	ø 5/8"
idem ø 20	idem	ø 3/4"
idem ø 25	idem	ø 1"
idem ø 32	idem	ø 1 1/4"
idem ø 45	idem	ø 1 3/4"
idem ø 50	idem	ø 2"
Bolt and nut M6	Bolt and nut	Ww 1/4"
idem M5	idem	Ww 3/16"
idem M8	idem	Ww 5/16"
idem M12	idem	Ww 1/2"

The construction of the components are described in the sequence of the drawings and the components lists. Numbers in square brackets refer to the component's numbers in the drawings and in the components lists. Numbers in round brackets refer to the detail part numbers in the components lists.

***All sizes are given in millimetres unless otherwise stated!***

# **9 Construction of the frame and the transmission**

## **9.1 Construction of the frame**

### **[1] Ground frame**

Drawing CF-02

- Cut the five pieces (1.1(2)/1.2/1.3/1.4) of MS angle iron 25 x 25 x 3 into the correct length with the correct angles.
- Arrange the four outer pieces (1.1(2)/1.2/1.4) with the topside down on a straight surface.
- Spot weld the four pieces together.
- Correct the shape if necessary until the front part (1.2) and rear part (1.4) are parallel and the diagonals of the frame are the same.
- Weld the four pieces together. Do not weld the front topside since the pedal hinges [4] (or [4a]) will have to be weld here later.
- Level the front topside by grinding, if it is not plain after welding.
- Remove 5 x 45° from the fifth piece (1.3) by grinding, filing or sawing.
- Clamp this piece, parallel with the rear part (1.4) at an inside distance of 100mm, inside the frame.
- Weld the piece inside the frame.
- Grind the front edges of the ground frame to make the front supports [9] fit properly around these edges.

To ease the construction of the ground frame a welding fixture in which all five pieces are fixed in proper positions can be made first. The frame is then welded together all at once.

### **[2] Front legs**

Drawing CF-03

- Cut the three pieces (2.1(2)/2.2) of MS angle iron 25 x 25 x 3 into the correct length with the correct angles.

- Mark the position of the four  $\varnothing 9$  holes and drill the holes in the small piece (2.2).
- Make two slots from the holes by filing or punching.
- Remove  $5 \times 45^\circ$  from the piece by grinding, filing or sawing.
- Arrange the two legs (2.1(2)) and clamp the small piece (2.2) into the legs.
- Correct the position of the small piece until it is parallel to the base of the two legs and is positioned on the proper height.
- Spot weld the two legs first at the top.
- Weld the small piece to the legs. Do not weld on top of the small piece, since this topside should remain plain to be able to mount the front driving wheel bearing support at a later stage.
- Weld the two legs at the top.

To ease the construction of the front legs a welding fixture in which the 3 pieces are fixed in proper position can be made first. All parts are then welded together all at once.

### **[3] Rear leg**

Drawing CF-03

- Cut the two pieces (3.1/3.2) of MS angle  $25 \times 25 \times 3$  into the correct length.
- Remove  $5 \times 45^\circ$  and  $10 \times 45^\circ$  by filing or sawing.
- Mark the position of the four  $\varnothing 9$  holes and drill the holes in the long piece (3.1).
- Make two slots from the holes by filing or punching.
- Clamp the small piece (3.2) in proper position, square and at the correct height, to the long piece (3.1).
- Weld the pieces together.

### **[4] Pedal hinge (2)**

Drawing CF-04

In case no MS UNP 3 is available, skip this description and follow the description of *[4a] Pedal hinge – alternative design*.

- Cut the two pieces (4.1(2)) of MS UNP 3  $30 \times 30 \times 3$  into the correct length.
- Cut the two pieces (4.2(2)) of MS flat  $25 \times 5$  into the correct length.
- Clamp the MS flat pieces and MS UNP pieces together.
- Weld the pieces together. Do not weld inside the MS UNP 3 pieces,



since the inside surface should be smooth to be able to mount a piece of leather [5] at a later stage.

- Mark the position of the  $\varnothing$  7 holes and drill the holes through both sides of the MS UNP 3 pieces.

**[4a] Pedal hinge – alternative design (2)**

Drawing CF-04

- Cut the four pieces (4a.1(2)/4a.2(2)) of MS Flat 25 x 3 into the correct length.
- Bend the two pieces of 61mm (4a.1) in a square angle with inside lengths of 25 and 33mm.
- Mark the position of the  $\varnothing$  7 holes and drill the holes through the two pieces of 73mm (4a.2).
- Bend these pieces tapering with an outside top distance of 25mm and an inside bottom radius of 8mm.
- Grind one bottom side edge of the tapering pieces if it does not fit into the curved corner of the square piece.
- Clamp the tapering pieces inside the square pieces.
- Weld the pieces together. Do not weld inside the tapering pieces, since the inside surface should be smooth to be able to mount a piece of leather [5] at a later stage.

**[5] Piece of leather (2)**

Drawing CF-04

- Cut two pieces of leather of 3mm thickness into 20mm width and 60mm length.
- Mark the position of the  $\varnothing$  7 holes.
- Punch or cut the  $\varnothing$  7 holes in the leather pieces.

**[9] Front support (2) and**

Drawing CF-04

**[10] Rear support**

- Cut the three pieces (9.1(2)/10.1) of MS angle 25 x 25 x 3 into the correct length.
- Cut the three pieces (9.2(2)/10.2) of MS round  $\varnothing$  32 into the correct length.
- Brake the edges of the MS round pieces.
- Bend two MS angle pieces into an angle of 77.6°.
- Clamp the MS angle pieces and MS round pieces together.
- Weld the pieces together.

- Cut the piece of MS Flat 25 x 3 into the correct length.
- Mark the position of the  $\varnothing$  13 holes and the drill the holes through the piece.

## **9.2 Assembling the charkha frame**

Refer to drawing CF-05

- Mark the middle of the front (1.2) and the rear (1.4) piece on top of the ground frame [1].
- Mark the position of the rear leg [3] with regard to the middle of the rear piece (1.4) 25mm left from the middle.
- Mark the position of the inside faces of the front legs [2] on top of both pieces (1.1) of the ground frame. The inside faces of the front legs should be parallel to the front and rear pieces of the ground frame at a distance of 100mm from the rear piece.

### **Welding the rear leg on the ground frame**

- Position the rear leg [3] along the mark on top of the ground frame [1].
- Check if the rear leg's position is square, from all sides, to the top level of the ground frame.
- Spot weld the pieces together and check the rear leg's position again.
- Weld the pieces together.
- Check after welding if the rear leg's position still is square to the top level of the ground frame. Adjust if necessary.

### **Welding the front legs and cross beam to the ground frame**

- Clamp the cross beam [11] on top of the small MS angle piece of the rear leg [3] parallel to the centre line of the ground frame [1].
- Position the front legs [2] at the bottom along the mark on top of the ground frame and at the top under the cross beam.
- Check if the front legs' position is square to the top level of the ground frame, with the top of the legs above the centre line of the ground frame.

- Spot weld the pieces together and check the front legs' position and the cross beam's position again. Correct if necessary.
- Weld all the pieces together. First make the welded parts parallel to the centre line of the ground frame and then the welded parts square to this centre line, to prevent the legs from tilting.

To ease the construction of the charkha frame a welding fixture in which the front legs, the rear leg and the cross beam are fixed in proper positions on the ground frame can be made first. All parts are then welded together all at once.

### **Welding the front and rear supports to the ground frame**

- Place the ground frame [1] on a plain surface on top of some pieces of iron or wood to create a 20mm gap between the frame and the surface.
- Position the two front supports [9] on the plain surface around the front edges of the ground frame.
- Weld the pieces together.
- Position the rear support [10] on the plain surface against the middle of the rear piece (1.4) of the ground frame.
- Weld the pieces together.

### **Welding the pedal hinges on top of the ground frame**

- Put the pedal hinges [4] or [4a] around both ends of a straight piece of MS round  $\varnothing$  16 and a length of 360mm.
- Position the two pedal hinges symmetrically on top of the ground frame [1] with the centre line of the MS round piece above and in line with the inside side of the front piece (1.2) of the ground frame.
- Weld the pedal hinges and ground frame together.

To ease welding the pedal hinges on top of the groundframe, a welding fixture in which the pedal hinges are fixed in proper position on top of ground frame can be made. All the parts are then welded together all at once.

*Paint the frame after it is assembled and cleaned.*

## **9.3 Construction of the driving wheel**

### **[12] Bicycle wheel**

Drawing CF-06

An 18 inch bicycle front wheel is used as the charkha's driving wheel.

- Remove the shaft, the balls and the cups of the bicycle wheel bearings out of the hub.
- Count the number of spokes in the bicycle wheel.
- Mark six holes of  $\varnothing 7$  if the wheel contains 36 spokes. Start with the already present hole for the air valve and mark after each sixth spoke.
- Mark eight holes of  $\varnothing 7$  if the wheel contains 32 spokes. Start with the already present hole for the air valve and mark after each fourth spoke.
- Drill the holes in the bicycle wheel rim.

### **[13] Rubber rim tape**

Drawing CF-06

Make or have a rubber rim tape made of a used bicycle inner tube. The tape width should cover the rim completely in between the rim flanges.

### **[15] Weights**

Drawing CF-06

- Cut 6 pieces of MS round  $\varnothing 32$  into a length of 36mm if the wheel contains 36 spokes.
- Cut 8 pieces of MS round  $\varnothing 32$  into a length of 27mm if the wheel contains 32 spokes.
- Brake the edges of the weights.
- Mark the position of the  $\varnothing 5$  hole and drill the hole 20mm deep in the weights.
- Countersink the edge of the hole into 10 x 45°.
- Tap M6 threading 15mm deep in the hole.
- Paint the weights.

### **[16] Bearing support (2)**

Drawing CF-06

- Cut two pieces (16.1) of MS round  $\varnothing 50$  into 17mm length.
- Smooth both sides on a lathe to get pieces of 15mm length with smooth surfaces.

- Drill a hole of  $\varnothing$  25 through the centre of the pieces.
- For the front bearing support turn out a chamber of  $\varnothing$  36 and 12mm deep.
- For the rear bearing support turn out a chamber of  $\varnothing$  34 and 12mm deep.
- Make two V-shaped grooves, 1mm deep inside the chambers.
- Cut the four pieces (16.2) of MS flat 25 x 5 into the correct length.
- Mark the position of the  $\varnothing$  9 holes and drill the holes through the pieces.
- Clamp two MS flat pieces and one lathed MS round piece in proper position (80mm between the centres of the  $\varnothing$  9 holes) on a piece of iron. Notice that the MS flat pieces are not symmetrical. Position them correctly to each other and the chamber in the MS round piece.
- Weld the pieces together.
- Level the bottom sides of the bearing supports by grinding if they are not plain any more after welding.
- Paint the bearing supports.

To ease welding the bearing supports a welding fixture in which the MS flat pieces and the MS round piece are fixed in their proper positions can be made first. All parts are then welded together all at once.

### **[17] Piece of leather**

Drawing CF-06

- Cut two pieces of leather of 2.5mm thickness into 15mm width and 110mm length.
- Reduce the length of the leather pieces so that they fit without overlap inside the chamber of the bearing supports [16].
- Notice the difference in length of the leather pieces for the front and rear bearing supports because of their different chamber diameters.

### **[18] Bush (2)**

Drawing CF-07

- Cut two pieces of MS round  $\varnothing$  32 into 12mm length.
- Smooth both sides on a lathe to get pieces of 10mm length with smooth surfaces.
- Drill a hole of  $\varnothing$  12.5 through the centre of the bush.
- Measure with a sliding gauge the inside diameters  $\varnothing$  A and  $\varnothing$  B of the hub of the bicycle wheel [12] (refer to drawing CF-07).

- Turn half (5mm) of the outer diameter of the bush to a size of  $A + 0.02\text{mm}$  and the other half (5mm) to a size of  $B - 0.1\text{mm}$ .
- Brake all edges.

To ease lathing the outside diameter of the bush a special fixture, mounted in the chuck of the lathe can be made first. This fixture remains in the chuck and the bush is mounted on the fixture with a washer and a bolt.

## **[19] Wheel shaft**

Drawing CF-07

- Cut a straight piece of MS round  $\varnothing 16$  into 182mm length.
- Turn the wheel shaft on a lathe according to the sizes in drawing CF-07.
- Take special care of the measurements of 12.02mm and 10.02mm, since these shaft parts have to be press-fitted in the ball-bearings at a later stage.
- Take care that the threads of M12 and M8 are concentric and in line, otherwise the shaft will bend when the nuts are tightened.
- Prepare by milling or filing the flat sides as shown in the sections A-A and B-B.

## **9.4 Assembling the driving wheel**

### **Mounting the weights and rim tape**

Drawing CF-06

- Fix the weights [15] tightly to the rim of the bicycle wheel [12] with M6 slotted countersunk head screws [14] mounted through the holes drilled in the bicycle wheel rim (refer to section A-A).
- Mount the rubber rim tape [13] around the rim between the flanges.

### **Assembling the hub and the bearings**

Drawing CF-08

- Press-fit both bushes [18] inside the hub of the bicycle wheel [12].
- Fit the leather pieces [17] inside the bearing supports [16].
- Press-fit the front ball-bearing [20] and the rear ball-bearing [23] in the applicable bearing support [16] inside the chamber with leather coating. Use leather of a larger thickness if the ball-bearings are not tightly fixed in the bearing support.
- Take care that new sealed dust proof ball-bearings are used.

## 9.5 Construction of the transmission

### [28] Connecting rod

Drawing CF-09

The connecting rod is made from a sewing-machine connecting rod which is available in any shop selling sewing-machine spare parts.

- Bend the shaft of the ready-made sewing-machine connecting rod in a square angle according to the given sizes.
- Extend the M6 threading of the bent end before cutting to get a proper threading.
- After threading cut the bent end into proper length of 40mm.
- Brake the edges.

Take care to use M6 threading since the ready-made shaft of the sewing-machine connecting rod is too small for proper Ww 1/4" threading.

### [31] Leather washer (2)

Drawing CF-09

Leather washers are available in shops selling spare parts of water pumps. Take care that the washers are of uniform thickness of approximate 3mm. Reduce the thickness of the washers if they are thicker than 3.5.

### [32] Cross-head and

Drawing CF-09

### [33] Nylon bush

Nylon bushes [33]  $\varnothing 1" \times \varnothing 1/2" \times 1"$  are available in shops selling spare parts of water pumps.

- Cut the piece (32.1) of MS round  $\varnothing 32$  into 26mm length.
- Smooth both sides on a lathe to get a piece of 24mm length with smooth surfaces.
- Drill a hole of  $\varnothing 22$  through the centre of the piece.
- Turn the hole out to a size of  $\varnothing 24.8$ .
- Brake all edges.
- Cut the piece (32.2) of MS round  $\varnothing 16$  into 22mm length.
- Smooth both sides on a lathe to get a piece of 20mm length with smooth surfaces.
- Drill a hole of  $\varnothing 6$  through the centre of the piece.

- Brake the edges of the hole.
- Clamp the two pieces of MS round  $\varnothing$  32 and  $\varnothing$  16 together. Take care that the centre lines of the holes of both pieces are square.
- Weld the pieces together.
- Press-fit the nylon bush [33] inside part (32.1) of the cross-head [32].
- Clamp a  $\varnothing$  12.5 drill in a jaw vice and – if the hole in the nylon bush is rough and partly smaller than 12.5mm – ream the inside diameter by rotating the cross-head with the nylon bush inside, around the drill.
- Paint the cross-head, except the inside of the hole.

To ease welding of the cross-head a welding fixture in which the piece of MS round  $\varnothing$  32 and the piece of MS round  $\varnothing$  16 are fixed in proper position can be made first. Both pieces are then welded together all at once.

### **[35] Crank head**

Drawing CF-09

- Cut the piece of MS round  $\varnothing$  32 into 27mm length.
- Smooth both sides on a lathe to get a piece of 25mm length with smooth surfaces.
- Drill a hole of  $\varnothing$  11 through the centre of the piece.
- Brake the edges of the crank head.
- Mark the position of the  $\varnothing$  7 hole and drill the hole in the crank head.
- Countersink the edge of the hole.
- Tap M8 threading in the hole.

### **[36] Crank arm**

Drawing CF-09

- Cut the two pieces (36.1/36.2) of MS flat 25 x 5 into the correct length.
- Mark the positions of the  $\varnothing$  12.5 holes and drill the holes in the MS flat pieces.

### **[37] Crank pin**

Drawing CF-09

- Cut the piece of MS round  $\varnothing$  16 into 85mm length. This length of 80mm includes extra length needed to mount the piece in the chuck of a lathe to be able to turn it properly. After lathing this extra length is cut off and can be used to prepare the cross-head [32].
- Turn the crank pin on a lathe according to the sizes in drawing CF-09.



- Take care that the M8 threading is concentric and in line with the centre line of the crank pin.
- Cut after turning the extra length and smooth the surface on a lathe to get a  $\varnothing 16$  step of 5mm length.

### **Assembling the crank**

Drawing CF-09

- Put the crank pin [37] through the  $\varnothing 12.5$  holes of the two MS flat pieces of the crank arm [36] with the longest piece against the  $\varnothing 16$  step.
- Mount a bush of 35mm length (with smooth and proper parallel surfaces) and an inside diameter of 13mm over the crank pin and secure the crank pin in the two MS flat pieces with the help of a M8 nut and washer.
- First weld the two pieces of the crank arm together.
- Then weld the crank pin to the crank arm.
- Clamp the crank head [35] in proper position on the crank arm. Take care that the hole with M8 threading in the crank head faces upward.
- Mount a M8 bolt inside the hole to prevent the threading from damage by welding splatters.
- Weld the crank head to the crank arm.
- Paint the crank, except the crank pin.

## **9.6 Construction of the foot pedal**

### **[38] Pedal frame**

Drawing CF-10

- Cut the piece (38.1) of MS angle 25 x 25 x 3 into the correct length.
- Remove 10 x 45° from both ends of the piece by sawing.
- Mark the position of the  $\varnothing 7$  holes and drill the holes in the MS angle piece.
- Cut the piece (38.2) of MS flat 25 x 5 into the correct length.
- Mark the position of the  $\varnothing 7$  holes and drill the holes in the MS flat piece.
- Cut the piece (38.3) of MS round  $\varnothing 32$  into 14mm length.
- Smooth both sides on a lathe to get a piece of 12mm length with smooth surfaces.
- Drill a hole of  $\varnothing 17.5$  through the centre of the piece.
- Cut the two pieces (38.4(2)) of MS round  $\varnothing 10$  into the correct length. Take care that polished bar is used.
- Brake the edges of the MS round pieces.

- Clamp the two MS round pieces (38.4(2)) in proper position in line inside the corner of the MS angle piece (38.1).
- Weld the pieces together.
- Clamp the MS angle piece (38.1) and the MS flat piece (38.2) in proper position upside down on a plain surface.
- Weld the pieces together.
- Clamp the MS round piece (38.3) in proper position in front of the MS flat piece (38.2). Take care that the MS round piece is tilted 8° in regard to the MS flat piece.
- Weld the pieces together.
- Level the topside of the pedal frame by grinding, if it is not plain anymore after welding.
- Paint the pedal frame except for the protruding MS round  $\varnothing$  10 ends.

To ease welding the pedal frame a welding fixture in which the MS angle piece, the MS flat piece, the pieces of MS round  $\varnothing$  10 and the piece of MS round  $\varnothing$  32 are fixed in proper position can be made first. All parts are then welded together all at once.

### **[39] Pedal cover**

Drawing CF-10

- Use first-quality plywood of 10mm thickness for the pedal cover.
- Mark the shape of the pedal cover on a piece of plywood.
- Cut the pedal cover out of the piece of plywood or have the pedal cover made by a carpenter.
- Carefully polish the edges of the pedal cover with emery (sand) paper.
- Mark the position of the  $\varnothing$  6.5 holes and drill the holes in the pedal cover.

If several pedal cover have to be made, marking can be eased by making a template of MS sheet with the sizes of the pedal cover and with the  $\varnothing$  6.5 holes in their proper positions. With this template the shape and the positions of the holes can be marked at once.

### **Assembling the foot pedal**

Drawing CF-10

- Mount the pedal cover [39] on top of the pedal frame [38] with four M6 round head wood bolts [40] and four M6 nuts [41].
- Tighten the bolts and nuts that much, so the heads of the bolts are nearly at the same level as the top surface of the pedal cover.

## **9.7 Assembling the frame, driving wheel, foot pedal and transmission**

### **Mounting the driving wheel in the charkha frame**

Drawing CF-01  
Drawing CF-08

- Mount the wheel shaft [19] in the front ball-bearing [20] inside the bearing support [16]. Take care that the reduction step inside the bearing support is facing outward (refer to drawing CF-08).
- Place the driving wheel [12], with bushes [18] press-fitted in the hub, and already mounted weights [15] and rubber rim tape [13] between the front legs [2] and the rear leg [3] of the frame.
- Insert the wheel shaft through the front legs in the bushes inside the hub of the driving wheel. Take care that the bottom side of the bearing support is facing downward to the support inside the front legs.
- Mount a washer [21] and an M12 nut [22] on the protruding end of the shaft at the backside of the driving wheel. Fix the nut tightly by hand.
- Mount the bearing support [16], with the rear ball-bearing [23] inside, on the protruding end of the wheel shaft. Take care that the reduction step inside the bearing support is facing outward (refer to drawing CF-08) and take care that the bottom side of the bearing support is facing towards the rear leg.
- Secure the rear bearing support with M8 bolts [43], washers [44] and nuts [45] to the rear leg. Fix the bolts and nuts tightly by hand.
- Secure the front bearing support with M8 bolts [43], washers [44] and nuts [45] to the support inside the front legs. Fix the bolts and nuts tightly by hand.
- Secure the wheel shaft tightly in the hub of the driving wheel, holding the shaft with one spanner over the flattened sides on the shaft in between the front bearing support and the hub and a second spanner over the M12 nut at the rear of the hub. Secure the M12 nut very tightly.
- Mount a washer [24] and an M8 nut [25] on the protruding end of the wheel shaft at the backside of the rear bearing support.
- Secure the rear ball-bearing tightly on the wheel shaft, holding the wheel shaft with one spanner over the flattened sides on the shaft and a second spanner over the M8 nut. Take care that both the front and the rear bearing supports are loosely fixed to the front and the rear

legs, to make adjustment of both supports possible when the M8 nut is secured.

After the wheel shaft is tightly fixed to the driving wheel and the rear bearing support, the position of the driving wheel has to be checked and if necessary adjusted. Then the front and rear bearing supports are tightly secured to the front and the rear legs with the M8 bolts and nuts.

- Check if the driving wheel is tilted forward or backward in vertical direction.
- Measure the distance between the driving wheel rim and the front or rear leg, at the top of the leg and at the bottom of the leg. Both distances should be the same. Adjust the distances by moving the rear bearing support up or down.
- Adjust the position of the rear bearing support and secure the support tightly to the rear leg with the M8 bolts and nuts.
- Check if the driving wheel is tilted forward or backward in horizontal direction.
- Measure the distance between the driving wheel rim and the left and right leg of the front legs near the ground frame. Both distances should be the same. Adjust the distances by moving the front bearing support to the left or to the right.
- Adjust the position of the front bearing support and secure the support tightly to the support inside the front legs with the M8 bolts and nuts.

### **Mounting the foot pedal**

Drawing CF-01

Drawing CF-04

- Mount a piece of leather [5] in both pedal hinges [4] (or [4a]) on the ground frame. Take care that the  $\varnothing 7$  holes in the pieces of leather are in line with the  $\varnothing 7$  holes in the pedal hinges.
- Position the protruding ends of MS round  $\varnothing 10$  of the pedal frame [38], inside the pieces of leather inside the pedal hinges.
- Secure the foot pedal and the piece of leather in the pedal hinges with an M6 bolt [6], a washer [7] and a nut [8] (drawing CF-04).
- Tighten the nut just that much, so it will not get loose during the normal operation of the charkha.

## **Mounting the transmission**

Drawing CF-01

Drawing CF-09

The transmission consists of a crank (mounted on the wheel shaft), a cross-head (mounted on the crank arm) and a connecting rod (connected to the cross-head and the pedal frame).

- Mount the crank with the  $\varnothing$  11 hole in the crank head [35] around the protruding end of the wheel shaft [19] in front of the front legs [2]. Take care to mount the crank so far over the wheel shaft that the shaft touches the crank arm [36] at the front side of the crank head.
- Secure the crank head with the M8 bolt [34] on the wheel shaft. Take care that the bolt is tightened on the flattened side of the protruding end of the shaft to prevent the crank from slipping over the shaft.
- Mount a leather washer [31] on the crank pin [37] of the crank.
- Mount the cross-head [32] on the crank pin.
- Check if the cross-head can rotate easily around the crank pin. If not, the hole inside the nylon bush has to be smoothed and enlarged a little by reaming with a  $\varnothing$  12.5 drill.
- Mount a leather washer [31] on the crank pin in front of the cross-head.
- Mount a large washer [30] on the crank pin and secure this washer with an M8 nut [29].
- Check again if the cross-head can rotate easily around the crank pin. If rotating has become harder the leather washers are too thick and should be replaced by thinner ones.
- Never omit the leather washers since they prevent wearing of the crank arm and the cross-head.

The connecting rod [28] has a bend with M6 threading at one end and a small iron ball at the other end. The ball is fixed in a special nut and secured with a hollow screw. The play of the ball inside the special nut can be adjusted with this screw. The screw is secured with a counter nut.

- Remove the counter nut from the hollow screw but keep the screw inside the special nut.
- Insert the special nut from the top inside the  $\varnothing$  17.5 hole at the end of the pedal frame [38].
- Mount the counter nut again on the hollow screw and secure with

this nut both the special nut inside the  $\varnothing$  17.5 hole as well as the hollow screw inside the special nut.

- Check if the ball of the connecting rod can move easily in the special nut without having too much play. Adjust the play if necessary with the hollow screw. Secure the counter nut tightly after adjusting.
- Insert the bent end of the connecting rod from the right side inside the  $\varnothing$  6 hole in the cross-head [32].
- Secure this end with two M6 nuts [26] and a washer [27]. One nut is used to secure the other. Take care that the bent end can move easily inside the  $\varnothing$  6 hole without having too much play.

The driving belt [42] used in the Medleri Charkha is the same belt as used in foot-operated sewing-machines and can be bought in any shop selling sewing-machine spare parts.

The driving belt can only be mounted properly when a spinning-mechanism is attached to the charkha frame. In the next chapters the construction of a medium yarn spinning mechanism and a fine yarn spinning mechanism are described. Refer to paragraph 3.5 for the mounting of the driving belt.

# **10 Construction of the medium yarn spinning mechanism**

## **10.1 Construction of the spinning mechanism base**

### **[1] Main support**

Drawing MY-02

- Cut the two pieces (1.1/1.2) of MS angle 25 x 25 x 3 into the correct length.
- Remove 10 x 45° by sawing from the long piece (1.1).
- Clamp the small piece (1.2) properly against the long piece. Take care that the correct faces of the pieces are clamped together and that the two pieces form a proper rectangle of 25mm width and 28mm height.
- Mark the position of the  $\varnothing$  12.5 holes and the drill the holes proper square through both MS angle pieces. Do not drill the holes at once but pre-drill with a drill of  $\varnothing$  6.

### **[2] Front flyer support**

Drawing MY-02

- Cut the two pieces (2.1(2)) of MS angle 25 x 25 x 3 into the correct length.
- Remove 10 x 45° and 15 x 45° from both pieces by sawing. Take care to remove the 10 x 45° and 15 x 45° from the proper faces of the pieces.
- Clamp the two pieces around a prepared piece of iron of 44mm width to position the pieces.
- Weld the pieces together. Do not weld inside.
- Grind the welded joint till the surface is even.
- Cut the piece (2.2) of MS flat 25 x 5 into the correct length.
- Grind the edges of the piece, so it fits well in the curved corners of the joined MS angle pieces.

- Position the piece inside the joined MS angle pieces. Take care that the MS flat piece is proper square to all sides of the joined MS angle pieces.
- Weld the pieces at the bottom side together. Inside the front flyer support the surfaces must be plain to be able to mount the wooden bearing properly at a later stage.
- Grind the bottom side of the front flyer support until the surface is plain and square to all sides.
- Mark the position of the  $\varnothing 7$  hole and drill the hole in the front side of the front flyer support.
- Mark the position of the  $\varnothing 4.2$  hole and drill the hole in the left side of the front flyer support.
- Remove any burrs from the edge of the hole. Take care not to countersink the edge too deep since else no proper M5 threading can be made.
- Tap M5 threading in the hole.

To ease the construction of the front flyer support a welding fixture in which the three pieces are fixed in proper position can be made first. Then all pieces are welded together all at once.

### **[3] Guide**

Drawing MY-02

- Cut the piece of MS flat 20 x 3 into the correct length.
- Mark the positions of the  $\varnothing 6.5$  and  $\varnothing 10.5$  holes and drill both holes in the piece. Pre-drill the  $\varnothing 10.5$  hole with the drill of  $\varnothing 6.5$ .
- File or punch the  $\varnothing 10.5$  hole into a square hole of 10.5 x 10.5mm.
- Bend both sides of the piece in a square angle with an inside distance of 40mm between both sides. Take care that the centre line through the holes is parallel to the backside.

### **[5] Rear support**

Drawing MY-02

- Cut the two pieces (5.1/5.2) of MS flat 25 x 5 into the correct length.
- Remove 15 x 45° from the small piece (5.1) by sawing.
- Mark the position of the two  $\varnothing 9$  holes and drill the holes in the long piece (5.2).
- Make a slot from the holes by filing or punching.
- Clamp the small piece (5.1) against the centre line of the long piece (5.2). Take care that the bottom of the small piece is proper square to the back of the long piece.



- Weld the pieces together.

### **Assembling the spinning-mechanism base**

Drawing MY-02

- Clamp the front flyer support [2] square on top of the main support [1] at a distance of 328mm from the rear side. Take care to clamp the front flyer support on the proper face of the main support.
- Weld the pieces together.
- Clamp the rear support [5] square on top of the main support [1] at the correct distance of 58mm from the rear side of the main support.
- Weld the pieces together.
- Clamp the guide [3] aligned with the front side of the front flyer support [2] against the right side of the front flyer support. Take care that the bent side with the  $\varnothing$  6.5 hole is at a distance of 15mm below the front flyer support with the  $\varnothing$  6.5 hole facing downward.
- Weld the pieces together properly. Do not weld the bent sides.
- Insert the two hexagon M12 bolts [4] from the top through the two  $\varnothing$  12.5 holes in the main support [1].
- Secure the two bolt temporarily with a counter nut.
- Check if the bolts are square to the bottom side of the main support.
- Weld the bolt heads to the top side of the main support.
- Paint, except for the thread ends, the spinning mechanism base.

To ease construction of the spinning mechanism base a welding fixture in which the main support, the front flyer support and the rear support are fixed in proper position can be made first. Then all components are welded together all at once.

## **10.2 Construction of the wooden bearing and brake mechanism**

### **[6] Wooden bearing**

Drawing MY-03

The piece of wood is used as bearing for the orifice of the flyer. If only one bearing has to be made a wooden piece of 110mm length is needed. If two bearings have to be made, both can be made out of one piece of wood of 180mm length.

- Level the piece of wood into 44mm width and 14mm thickness.
- Brake the edges at one side into 4 x 45°.

- Mark the position of the  $\varnothing$  16 hole and drill the hole through the piece. Take care that the drilled hole gets a smooth surface.
- Brake the edges of the hole with emery (sand) paper.
- Cut the piece through the centre of the  $\varnothing$  16 hole.
- Check the length of the piece from the centre of the  $\varnothing$  16 hole to the bottom of the piece. Correct in the bottom if necessary.
- Remove  $20 \times 12^\circ$  from both sides of the top of the piece.
- Mark the position of the  $\varnothing$  6.5 hole and drill the hole through the front side of the piece of wood.
- Mark the position of the second  $\varnothing$  6.5 hole and drill the hole 10mm deep in the left side of the piece wood.

## **[12] Leather brake**

Drawing MY-03

- Cut the piece of leather of 2mm thickness into 12mm width and 140mm length.
- Mark the position of the  $\varnothing$  5 holes.
- Punch or cut the  $\varnothing$  5 holes in the leather piece.

## **[13] Regulator**

Drawing MY-03

- Cut the piece of MS square 10 x 10 into 52mm length.
- Smooth both sides on a lathe to get a piece of 50mm length with smooth surfaces.
- Taper, on a lathe, both ends of the piece in a top angle of  $40^\circ$  until the shape of the ends just become a circle.
- Drill, on a lathe, a hole of  $\varnothing$  5, 15mm deep in the centre of one side of the piece.
- Countersink the edge of the hole.
- Tap M6 threading 10mm deep in the hole.
- Mark the position of the  $\varnothing$  4.2 hole and drill the hole through the piece.
- Countersink the edges of the hole.
- Tap M5 threading in the hole.
- Secure the M6 bolt [16] very tightly in the hole with M6 threading.
- Cut the head of the tightly secured bolt. Take care not to damage the threading of the bolt.
- Brake the edge so a nut will run smoothly over the M6 threading.

## **[14] Spring**

Drawing MY-03

A compression spring used in some carburettor types is used as spring. Take a spring with dimensions matching the dimensions given in the drawing as much as possible.

## **[15] Regulator nut**

Drawing MY-03

- Cut the piece of MS round  $\varnothing$  20 into 17mm length.
- Smooth both sides on a lathe to get a piece of 14mm length with smooth surfaces.
- Drill a hole of  $\varnothing$  5 through the centre of the piece.
- Countersink both edges of the hole properly.
- Tap M6 threading in the hole.
- Turn on one side a step according to the drawing.
- Brake all edges.
- Knurl the remaining length of  $\varnothing$  20 to get a rough surface.

## **10.3 Construction of the rear flyer support and adjustment nut**

### **[17] Rear flyer support**

Drawing MY-04

In case no MS UNP 3 is available, skip this description and follow the description of [17a] *Rear flyer support – alternative design*.

- Cut the piece (17.1) of MS UNP 3 30 x 30 x 3 into the correct length.
- Cut the piece (17.2) of MS flat 25 x 5 into the correct length.
- Clamp the MS flat pieces and MS UNP pieces together.
- Weld the pieces together properly. Do not weld inside the MS UNP 3 piece since the inside surface should be smooth to be able to mount a piece of leather [18] properly at a later stage.
- Mark the position of the  $\varnothing$  7 hole and drill the hole through both sides of the MS UNP 3 piece.
- Mark the position of the  $\varnothing$  11 hole and drill the hole in the MS flat piece.
- Paint the rear flyer support.

### **[17a] Rear flyer support – alternative design**

Drawing MY-04

- Cut the piece (17a.1) of MS flat 25 x 3 into the correct length.
- Mark the position of the  $\varnothing 7$  holes and drill the holes through the MS flat piece.
- Bend the piece tapering with a outside top distance of 25mm and an inside bottom radius of 8mm.
- Cut the piece (17a.2) of MS flat 25 x 5 into the correct length.
- Clamp the tapering MS flat piece (17a.1) on top of this MS flat piece (17a.2).
- Weld the pieces together. Do not weld inside the tapering pieces since the inside surface should be smooth to be able to mount a piece of leather [18] at a later stage.
- Paint the rear flyer support.

### **[18] Piece of leather**

Drawing MY-04

- Cut the piece of leather of 4mm thickness into 20mm width and 60mm length.
- Mark the position of the  $\varnothing 7$  holes.
- Punch or cut the  $\varnothing 7$  holes in the leather piece.

### **[25] Adjustment nut**

Drawing MY-04

- Cut the two piece of MS round  $\varnothing 45$  into 10mm length.
- Smooth both sides on a lathe to get a pieces of 8mm length with smooth surfaces.
- Drill a hole of  $\varnothing 10$  through the centre of the pieces.
- Countersink both edges of the hole.
- Tap M12 threading in the hole. Take care that the threading is square to the surfaces of the pieces.
- Brake all edges.
- Knurl the  $\varnothing 45$  to get a rough surface.

## **10.4 Construction of the flyer**

### **[26] Orifice**

Drawing MY-05

- Cut the piece of MS round  $\varnothing 25$  into 47mm length.

- Smooth both sides on a lathe to get a piece of 45mm length with smooth surfaces.
- Mount the piece in the chuck of the lathe and turn of the step of  $\varnothing$  15.8 (length 15mm) first.
- Brake the edges as specified in the drawing.
- Release the piece from the chuck and mount it the other way around in the chuck. Take special care that the piece is running correctly, since all the faces of the orifice should be exactly concentric.
- Drill the hole of  $\varnothing$  5.9 in the centre of the orifice. Do not use a drill of  $\varnothing$  6 since the spindle [27] of  $\varnothing$  6 has to be press-fitted inside this hole of  $\varnothing$  5.9.
- Turn of the step of  $\varnothing$  16. Notice the tapering flange of  $25^\circ$ . Take special care to make this flange with a correct tapering of  $25^\circ$ .
- Mark a circle of  $\varnothing$  19 in the tapering flange. This circle is needed to determine the position of the  $\varnothing$  6.5 hole.
- Mark the position of the  $\varnothing$  6 hole and drill the hole through the step of  $\varnothing$  16. Take care that the centre line of the hole is square to the centre line of the orifice.
- File away a little part of the step of  $\varnothing$  16, square to the  $25^\circ$  flange and parallel to the  $\varnothing$  6 hole (refer to drawing MY-05). This little part has to be removed to be able to drill the  $\varnothing$  6.5 hole through the orifice.
- Mark the position of the  $\varnothing$  6.5 hole in the  $\varnothing$  19 circle, square to the centre line of the  $\varnothing$  6 hole.
- Mount the orifice in an angle of  $25^\circ$  on the working table of a milling machine. Take care that the marked position of the  $\varnothing$  6.5 hole is in horizontal position.
- Drill the  $\varnothing$  6.5 hole through the orifice. The hole should come out in front of the orifice without touching the step of  $\varnothing$  15.8.
- Brake all the edges of the  $\varnothing$  6.5 hole since any sharp spot will cause breakage of spun yarn.

To ease drilling the  $\varnothing$  6.5 hole a drilling aid in which the orifice is fixed in proper position can be made first. Then the  $\varnothing$  6.5 hole is drilled at once.

### **[27] Spindle**

Drawing MY-05

- Cut the piece of MS round  $\varnothing$  6 into 240mm length. Take care that a straight polished bar of MS round  $\varnothing$  6 is used.
- Brake the edges. Press-fitting the spindle inside the orifice [26] cannot be done if there are burrs.

## **[28] Arm (2)**

Drawing MY-05

- Cut two pieces of MS round  $\varnothing 6$  into 230mm length. Take care that a straight polished bar of MS round  $\varnothing 6$  is used.
- Bend a square angle in the pieces. Take care that the length of both sides of the square exceeds the needed length.
- Cut the length of both sides of the square into the correct dimensions of 160mm and 60mm.
- Mark the position of the  $\varnothing 3$  holes and drill the holes through both arms. Notice that the positions of the holes differ in both arms.

## **[29] Hook (12)**

Drawing MY-05

The hooks [29] needed for the flyer can be made either from screw hooks or screw eyes which are available in a carpentry shop or a general store. Use screw hooks or screw eyes which dimensions closest to the dimensions given.

- Make screw hooks from screw eyes by removing one quarter of the eye.
- Brake the edges of the hooks.
- Cut the screw hooks into proper length.

## **Assembling of the flyer**

Drawing MY-05

- Heat the orifice [26] until it becomes red-hot.
- Quickly press-fit the spindle [27] into the  $\varnothing 5.9$  hole with the help of a hammer. Take care that the spindle does not bend.
- Let the orifice with the spindle cool down.
- Check the spindle length of 215mm and correct if necessary.
- Brake the spindle end.
- Insert both arms [28] in the  $\varnothing 6$  holes in the orifice.
- Place the orifice with the spindle and the arms on a plain surface. Put a piece of iron on top to prevent the pieces from moving.
- Position the arms parallel to the spindle and weld them to the orifice. Take care that welding splatters do not damage the  $\varnothing 6.5$  hole inside the orifice or the spindle. Remove splatters.
- Insert the hooks [29] in the  $\varnothing 3$  holes in the arms until they protrude at the backside. Take care that the hooks are at the same side of the arms of the flyer as the  $\varnothing 6.5$  hole in the orifice is.

- Position the hooks in the long sides of the arms with the closed side facing towards the spindle.
- Position the two hooks in the short sides of the arms in an angle of 45° with the closed side of the hook facing towards the spindle.
- Fix all hooks with accurate spot welds on the protruding ends at the backside of the arms.

## 10.5 Construction of the bobbins

### [30] Pulley (6)

Drawing MY-06

- Use pieces of hard wood to prepare the six pulleys.
- Turn the outer diameter with the groove into correct dimensions on a lathe. Prepare a special cutting tool in the shape of the groove.
- Measure the outside diameter of the PVC pipe, used for the stem [31], with a sliding gauge.
- Drill, in a lathe, a hole of  $\varnothing$  23 in the centres of the pulleys and turn this hole out until a stem fits gently inside the hole. Check and correct the size of the hole if necessary.
- Make in one pulley of each bobbin a small groove inside the hole to be able to fix a loop [33] of artificial silk yarn.

### [31] Stem (3)

Drawing MY-06

- Cut the three pieces of  $\varnothing$  25 PVC pipe into 182mm length.
- Smooth both sides on a lathe to get pieces of 180mm length with smooth surfaces.
- Measure the inside and outside diameters of the PVC pipe with a sliding gauge. These measurements are needed to prepare the pulleys [30] and the plugs [32].

### [32] Plug (6)

Drawing MY-06

- Use a piece of hard wood to prepare the six plugs.
- Measure the inside diameter of the PVC pipe, used for the stem [31], with a sliding gauge.
- First turn off the outer diameter until the plugs fit gently inside the stem. Check and correct the size of the outer diameter if necessary.
- Brake the edge of one side into 2 x 45°.
- Drill, in a lathe, holes of  $\varnothing$  6.5 in the centre of the plugs.
- Brake the edge of the hole at one side into 3 x 45°. Braking this

edge is done to ease mounting the bobbin around the spindle of the flyer.

### **Assembling the bobbins**

Drawing MY-06

- Mount two plugs [32] with two-components glue inside a stem [31]. Take care that the broken edges are facing inwards and that the outer surfaces of the plugs are at the same level as the outer ends of the stem.
- Mount a loop of artificial silk yarn [33] in the groove of a pulley [30].
- Mount this pulley with two-components glue around a stem [31].
- Mount a pulley without a groove around the other end of the stem with two-components glue.
- Take care that the outer surfaces of the pulleys are at the same level as the outer ends of the stem.

## **10.6 Assembling the medium yarn spinning mechanism**

### **Mounting the wooden bearing in the front flyer support**

Drawing MY-03

- Position the wooden bearing [6], with the broken edges facing forward, inside the front flyer support [2] on the spinning-mechanism base.
- Fix the wooden bearing with an M6 round head wood bolt [7], a nut [8] and a washer [9] to the front flyer support.
- Tighten the bolt and nut, so that the head of the bolt is nearly at the same level as the top surface of the wooden bearing.

### **Mounting the brake mechanism**

Drawing MY-03

- Secure one side of the leather brake [12] with an M5 bolt [10] and washer [11] in the hole with M5 threading in the regulator [11]. Take care that the leather brake is parallel to the regulator.
- Insert the thread end of the regulator [11] from the top through the square hole in the guide [3] on the spinning mechanism base. Do not insert the thread end through the  $\varnothing$  6.5 hole in the guide yet.
- Put the spring [14] over the thread end and over the square part of the regulator against the guide.



- Turn the regulator nut [15] on the thread end. Take care that the spring is falling around the step of the regulator nut.
- Insert the protruding thread end through the  $\varnothing$  6.5 hole in the guide.
- Turn the regulator nut until the square part of the regulator is inserted for 10mm inside the guide. Take care that the M5 bolt and leather brake are facing towards the front flyer support [2].
- Secure the other end of the leather brake with an M5 bolt [10] and washer [11] in the hole with M5 threading in the left side of the front flyer support. Take care that the leather brake is parallel to the regulator and the wooden bearing [6].

### **Mounting the rear flyer support base**

Drawing MY-04

- Mount the piece of leather [16] in the rear flyer support [17] (or [17a]). Take care that the  $\varnothing$  7 holes in the piece of leather are in line with the  $\varnothing$  7 holes in the rear flyer support.
- Secure the piece of leather in the rear flyer support with an M6 bolt [19], washer [20] and nut [21].
- Tighten the nut just, so that it will not get loose during normal operation of the charkha.
- Mount the rear flyer support tightly by hand to the rear support [5] of the spinning mechanism base with an M8 bolt [22], nut [24] and washers [23].
- Insert the spindle [27] of the flyer on top of the piece of leather in the rear flyer support, under the M6 bolt.
- Bend the leather brake [12] slightly forward and place the front part of the orifice [26] of the flyer on top of the wooden bearing [6] inside the front flyer support [2].
- Check if the spindle of the flyer is parallel to and in line with the main support [1] of the spinning mechanism base. Correct if necessary by adjusting the position of the rear flyer support.
- Secure the rear flyer support by turning on the M8 bolt and nut tightly.

### **Mounting the medium yarn spinning mechanism**

Drawing MY-01

Drawing CF-01

- Mount the two adjustment nuts [25] on the two protruding thread ends of the M12 bolt [4].
- Turn both adjustment nuts in a position close to the main support [1].

- Insert the thread ends in the two holes in the cross beam of the charkha frame. Take care that the front flyer support [2] is in front.
- Adjust the position of the spinning mechanism until the main support is parallel with the cross beam of the charkha frame.
- Mount the M12 nuts [34] on the thread ends underneath the cross-beam.
- Turn on these counter nuts until they touch the cross beam.
- Secure the spinning mechanism by turning on the adjustment nuts tightly.

### **Mounting the flyer and the bobbin**

Drawing MY-01

- Insert the spindle [27] of the flyer without force into the hole in the plug [32] of the bobbin.
- Rotate and align the bobbin on the spindle until it fits.
- Place the spindle end in the piece of leather [18] under the bolt [19] of the rear flyer support [17] (or [17a]). Take care that the spindle end is not placed on top of the bolt.
- Bend the leather brake [12] slightly forward and place the orifice [26] of the flyer on top of the wooden bearing [6] inside the front flyer support [2].
- Put the leather brake over the orifice.

# **11 Construction of the fine yarn spinning mechanism**

## **11.1 Construction of the spinning mechanism base**

### **[1] Main support**

Drawing FY-02

- Cut the two pieces (1.1/1.2) of MS angle 25 x 25 x 3 into the correct length.
- Remove 10 x 45° by sawing from the long piece (1.1). Take care to remove the 10 x 45° from the correct face of the piece.
- Clamp the small piece (1.2) against the long piece. Take care that the correct faces of the pieces are clamped together and that the two pieces form a rectangle of 25 width and 28 height.
- Mark the position of the  $\varnothing$  12.5 holes and drill the holes square through both MS angle pieces. Do not drill the holes at once but pre-drill with a drill of  $\varnothing$  6.
- Mark the positions of the  $\varnothing$  5 and  $\varnothing$  3 holes and drill both holes in the long piece.

### **[2] Front flyer support**

Drawing FY-02

- Cut the two pieces (2.1(2)) of MS angle 25 x 25 x 3 into the correct length.
- Remove 10 x 45° and 15 x 45° from both pieces by sawing. Take care to remove the 10 x 45° and 15 x 45° from the proper faces of the pieces.
- Clamp the two pieces around a prepared piece of iron of 44mm width to position the pieces.
- Weld the pieces together. Do not weld inside.
- Grind the welded joint until the surface is even.
- Cut the piece (2.2) of MS flat 25 x 5 into the correct length.

- Grind the edges of the piece, so it fits well in the curved corners of the joined MS angle pieces.
- Position the piece inside the joined MS angle pieces. Take care that the MS flat piece is square to all sides of the joined MS angle pieces.
- Weld the pieces at the bottom side together. Inside the front flyer support the surfaces must be plain to be able to mount the wooden bearing at a later stage.
- Grind the bottom side of the front flyer support until the surface is plain and square to all sides.
- Mark the position of the  $\varnothing 7$  hole and drill the hole in the front side of the front flyer support.

To ease the construction of the front flyer support a welding fixture in which the 3 pieces are fixed in proper position can be made first. Then all pieces are welded together all at once.

### **[3] Guide**

Drawing FY-02

- Cut the piece of MS flat 20 x 3 into the correct length.
- Mark the positions of the  $\varnothing 6.5$  and  $\varnothing 10.5$  holes and drill both holes in the piece. Pre-drill the  $\varnothing 10.5$  hole with the drill of  $\varnothing 6.5$ .
- File or punch the  $\varnothing 10.5$  hole into a square hole of 10.5 x 10.5.
- Bend both sides of the piece in a square angle with an inside distance of 40mm between both sides. Take care that the centre line through the holes is parallel to the backside.

### **[5] Rear support**

Drawing FY-02

- Cut the two pieces (5.1/5.2) of MS flat 25 x 5 into the correct length.
- Remove 15 x 45° from the small piece (5.1) by sawing.
- Mark the position of the two  $\varnothing 9$  holes and drill the holes in the long piece (5.2).
- Make a slot from the holes by filing or punching.
- Clamp the small piece (5.1) against the centre line of the long piece (5.2). Take care that the bottom of the small piece is proper square to the back of the long piece.
- Weld the pieces together.

### **[6] Hook**

Drawing FY-02

The hook [6] needed for the spinning mechanism base can be made

To ease construction of the spinning mechanism base a welding fixture in which the main support, front flyer support and rear support

- Paint, except for the thread ends, the spinning mechanism base.
- backsides of the MS angle piece.
- Fix the hook with an accurate spot weld on the protruding end at the downwards to the rear side.
- Position the hook in a 45° angle with the open part of the hook facing protrudes at the backsides of the MS angle piece.
- Insert the hook [6] in the  $\varnothing 3$  hole in the main support [1] until it just
- Weld the bolt heads to the top side of the main support.
- Check if the bolts are square to the bottom side of the main support.
- Secure the two bolt temporary with a counter nut.
- $\varnothing 12.5$  holes in the main support [1].
- Insert the two hexagon bolts of M12 [4] from the top through the two
- Weld the pieces together. Do not weld the bent sides.
- hole is facing to the front.
- side of the main support. Take care that the bent side with the  $\varnothing 6.5$  the main support [1] at the correct distance of 54mm from the front
- Clamp the guide [3] aligned above the centre line of the right side of
- Weld the pieces together.
- support.
- the correct distance of 335mm from the front side of the main
- Clamp the rear support [5] square on top of the main support [1] at
- Weld the pieces together.
- front flyer support on the proper face of the main support.
- [1] at a distance of 62mm from the front side. Take care to clamp the
- Clamp the front flyer support [2] square on top of the main support

### mechanism base

### Assembling the spinning

Drawing FY-02

- Cut the screw hook into proper length.
- Brake the edges of the hook.
- eye.
- Make a screw hook from a screw eye by removing one quarter of the
- much as possible (also refer to hook [28] in drawing FY-05).
- dimensions matching the dimensions given in drawing FY-02 as
- carpentry shop or general store. Use a screw hook or screw eye with
- either from a screw hook or a screw eye which are available in a

are fixed in proper position can be made first. Then all components are welded together all at once.

## **11.2 Construction of the wooden bearing and brake mechanism**

### **[7] Wooden bearing**

Drawing FY-03

The piece of wood is used as bearing for the orifice of the flyer. If only one bearing has to be made a wooden piece of 110mm length is needed. If two bearings have to be made, both can be made out of one wooden piece of 180mm length.

- Cut the piece of wood into 44mm width and 14mm thickness.
- Brake the edges at one side into  $4 \times 45^\circ$ .
- Mark the position of the  $\varnothing 16$  hole and drill the hole through the piece. Take care that the drilled hole gets a smooth surface.
- Brake the edges of the hole with emery (sand) paper.
- Cut the piece through the centre of the  $\varnothing 16$  hole.
- Check the length of the piece from the centre of the  $\varnothing 16$  hole to the bottom of the piece. Correct in the bottom if necessary.
- Remove  $20 \times 12$  from both sides of the top of the piece.
- Mark the position of the  $\varnothing 6.5$  hole and drill the hole through the piece.

### **[11] Regulator**

Drawing FY-03

- Cut the piece of MS square  $10 \times 10$  into 52mm length.
- Smooth off both sides on a lathe to get a piece of 50mm length with smooth surfaces.
- Taper, on a lathe, both ends of the piece in a top angle of  $40^\circ$  until the shape of the ends becomes a circle.
- Drill, on a lathe, a hole with a diameter of  $\varnothing 5$ mm and 15mm deep in the centre of one side of the piece.
- Countersink the edge of the hole.
- Tap M6 threading 10mm deep in the hole.
- Mark the position of the  $\varnothing 4.2$  hole and drill the hole through the piece.
- Brake the edges of the hole.
- Secure the M6 bolt [14] very tightly in the hole with M6 threading.

- ❑ Cut the head of the tightly secured bolt. Take care not to damage the threading of the bolt.
- ❑ Brake the edge so a nut will run smoothly over the M6 threading

### **[12] Spring**

Drawing FY-03

A compression spring used in some carburettor types is used as a spring. Take a spring with dimensions matching the dimensions given in the drawing as much as possible.

### **[13] Regulator nut**

Drawing FY-03

- ❑ Cut the piece of MS round  $\varnothing$  20 into 17mm length.
- ❑ Smooth both sides on a lathe to get a piece of 14mm length with smooth surfaces.
- ❑ Drill a hole of  $\varnothing$  5 through the centre of the piece.
- ❑ Countersink both edges of the hole.
- ❑ Tap M6 threading in the hole.
- ❑ Turn on one side a step according to the drawing.
- ❑ Brake all edges.
- ❑ Knurl the remaining length of  $\varnothing$  20 to get a rough surface.

### **[15] Adjustment nut**

Drawing FY-03

- ❑ Cut the two piece of MS round  $\varnothing$  45 into 10mm length.
- ❑ Smooth both sides on a lathe to get a pieces of 8mm length with smooth surfaces.
- ❑ Drill a hole of  $\varnothing$  10 through the centre of the pieces.
- ❑ Countersink both edges of the hole.
- ❑ Tap M12 threading in the hole. Take care that the threading is square to the surfaces of the pieces.
- ❑ Brake all edges.
- ❑ Knurl the  $\varnothing$  45 to get a rough surface.

## **11.3 Construction of the rear flyer support**

### **[16] Rear flyer support**

Drawing FY-04

In case no MS UNP 3 is available, skip this description and follow the description of *[16a] Rear flyer support – alternative design*.

- ❑ Cut the piece (16.1) of MS UNP 3 30 x 30 x 3 into the correct length.

- Cut the piece (16.2) of MS flat 25 x 5 into the correct length.
- Clamp the MS flat pieces and MS UNP pieces together.
- Weld the pieces together. Do not weld inside the MS UNP 3 piece, since the inside surface should be smooth to be able to mount a piece of leather [17] at a later stage.
- Mark the position of the  $\varnothing$  7 hole and drill the hole through both sides of the MS UNP 3 piece.
- Mark the position of the  $\varnothing$  11 hole and drill the hole in the MS flat piece.
- Paint the rear flyer support.

**[16a] Rear flyer support – alternative design**

Drawing FY-04

- Cut the piece (16a.1) of MS flat 25 x 3 into the correct length.
- Mark the position of the  $\varnothing$  7 holes and drill the holes through the MS flat piece.
- Berid the piece tapering with a outside top distance of 25mm and an inside bottom radius of 8mm.
- Cut the piece (16a.2) of MS flat 25 x 5 into the correct length.
- Clamp the tapering MS flat piece (16a.1) on top of this MS flat piece (16a.2).
- Weld the pieces together. Do not weld inside the tapering pieces since the inside surface should be smooth to be able to mount a piece of leather [17] at a later stage.
- Paint the rear flyer support, alternative design.

**[17] Piece of leather**

Drawing FY-04

- Cut the piece of leather of 4mm thickness into 20mm width and 60mm length.
- Mark the position of the  $\varnothing$  7 holes.
- Punch or cut the  $\varnothing$  7 holes in the leather piece.

**11.4 Construction of the flyer**

**[24] Orifice**

Drawing FY-05

- Cut the piece of MS round  $\varnothing$  32 into 74mm length.
- Smooth both sides on a lathe to get a piece of 72mm length with smooth surfaces.



- Mount the piece in the chuck of the lathe and turn of the steps of  $\varnothing$  15.8 (length 15mm) and  $\varnothing$  28 (length 33mm) first.
- Brake the edges as specified in the drawing.
- Release the piece from the chuck and mount it the other way around again in the chuck. Take special care that the piece is running correctly, since all the faces of the orifice should be exactly concentric.
- Drill the hole of  $\varnothing$  5.9 in the centre of the orifice. Do not use a drill of  $\varnothing$  6 since the spindle [26] of  $\varnothing$  6 has to be press-fitted inside this hole of  $\varnothing$  5.9.
- Turn of the step of  $\varnothing$  16. Notice the tapering flange of  $14^\circ$ . Take special care to make this flange with a correct tapering of  $14^\circ$ .
- Mark a circle of  $\varnothing$  21 in the tapering flange. This circle is needed to determine the position of the  $\varnothing$  8 hole.
- Mark the position of the  $\varnothing$  6 hole and drill the hole through the step of  $\varnothing$  16. Take care that the centre line of the hole is square to the centre line of the orifice.
- File away a little part of the step of  $\varnothing$  16, square to the  $14^\circ$  flange and parallel to the  $\varnothing$  6 hole. This little part has to be removed to be able to drill the  $\varnothing$  8 hole through the orifice.
- Mark the position of the  $\varnothing$  8 hole in the  $\varnothing$  21 circle, square to the centre line of the  $\varnothing$  6 hole.
- Mount the orifice in an angle of  $14^\circ$  on the working table of a milling machine. Take care that the marked position of the  $\varnothing$  8 hole is in horizontal position.
- Drill the  $\varnothing$  8 hole through the orifice. The hole should come out in front of the orifice without touching the step of  $\varnothing$  15.8.
- Brake all the edges of the  $\varnothing$  8 hole since any sharp spot will cause breakage of spun yarn.

To ease drilling the  $\varnothing$  8 hole a drilling aid in which the orifice is fixed in proper position and angle can be made first. Then the  $\varnothing$  8 hole is drilled at once.

## **[25] Pulley**

Drawing FY-05

- Use a piece of hard wood to prepare the pulley.
- Turn the outer diameter with the groove into correct dimensions on a lathe. Prepare a special cutting tool in the shape of the groove if more than one pulley has to be made.
- Drill, in a lathe, a hole of  $\varnothing$  25 in the centre of the pulley and turn the

hole out to  $\varnothing$  28. The orifice [24] should fit gently inside the hole of the pulley. Check and correct the size of the hole if necessary.

### **[26] Spindle**

Drawing FY-05

- Cut the piece of MS round  $\varnothing$  6 into 215mm length. Take care that a straight polished bar of MS round  $\varnothing$  6 is used.
- Brake the edges. Press-fitting the spindle inside the orifice [24] cannot be done if any burrs are there.

### **[27] Arm (2)**

Drawing FY-05

- Cut two pieces of MS round  $\varnothing$  6 into 220mm length. Take care that a straight polished bar of MS round  $\varnothing$  6 is used.
- Bend a square angle in the pieces. Take care that the length of both sides of the square exceeds the needed length.
- Cut the length of both sides of the square into the correct dimensions of 150mm and 60mm.
- Mark the position of the  $\varnothing$  3 holes and drill the holes through both arms. Notice that the positions of the holes differ in both arms.

### **[28] Hook (12)**

Drawing FY-05

The hooks [28] needed for the flyer can be made either from screw hooks or screw eyes which are available in a carpentry shop or general store. Use a screw hooks or screw eyes whith dimension matching the dimensions given in drawing FY-05 as much as possible.

- Make screw hooks from screw eyes by removing one quarter of the eye.
- Brake the edges of the hooks.
- Cut the screw hooks into proper length.

### **Assembling of the flyer**

Drawing FY-05

- Heat the orifice [24] until it becomes red-hot.
- Quickly press-fit the spindle [26] into the  $\varnothing$  5.9 hole with the help of a hammer. Take care that the spindle does not bend.
- Let the orifice with the spindle cool down.
- Check the spindle length of 190mm and correct if necessary.

- Brake the spindle end.
- Insert both arms [27] in the  $\varnothing$  6 holes in the orifice.
- Place the orifice with the spindle and the arms on a plain surface. Put a piece of iron on top to prevent moving of the pieces.
- Position the arms parallel to the spindle and weld them to the orifice. Take care that welding splatters do not damage the  $\varnothing$  8 hole inside the orifice or the spindle. Remove the splatters.
- Insert the hooks [28] in the  $\varnothing$  3 holes in the arms until they protrude at the backside. Take care that the hooks are at the same side of the arms of the flyer as the  $\varnothing$  8 hole in the orifice is.
- Position the hooks in the long sides of the arms with the closed side facing towards the spindle.
- Position the two hooks in the short sides of the arms in an angle of  $45^\circ$  with the closed side of the hook facing towards the spindle.
- Fix all hooks with accurate spot welds on the protruding ends at the backside of the arms.
- Fix the orifice with two components glue inside the pulley [25]. Take care that the pulley touches the  $\varnothing$  32 step.

## **11.5 Construction of the bobbins**

### **[29] Pulley (6)**

Drawing FY-06

- Use pieces of hard wood to prepare the six pulleys.
- Turn the outer diameter with the groove into correct dimensions on a lathe. Prepare a special cutting tool in the shape of the groove.
- Measure the outside diameter of the PVC pipe, used for the stem [30], with a sliding gauge.
- Drill, in a lathe, a hole of  $\varnothing$  23 in the centres of the pulleys and turn this hole out until a stem fits gently inside the hole. Check and correct the size of the hole if necessary.
- Make in one pulley of each bobbin a small groove inside the hole to be able to fix a loop [32] of artificial silk yarn.

### **[30] Stem (3)**

Drawing FY-06

- Cut the three pieces of  $\varnothing$  25 PVC pipe into 162mm length.
- Smooth both sides on a lathe to get pieces of 160mm length with smooth surfaces.
- Measure the inside and outside diameters of the PVC pipe with a

sliding gauge. These measurements are needed to prepare the pulleys [29] and the plugs [31].

### **[31] Plug (6)**

Drawing FY-06

- Use a piece of hardwood to prepare the six plugs.
- Measure the inside diameter of the PVC pipe, used for the stem [30], with a sliding gauge.
- First turn of the outer diameter until the plugs fit gently inside the stem. Check and correct the size of the outer diameter if necessary.
- Chamfer the edge of one side into 2 x 45°.
- Drill, in a lathe, holes of  $\varnothing$  6.5 in the centre of the plugs.
- Countersink the edge of the hole at one side into 3 x 45°. This is done to ease mounting the bobbin around the spindle of the flyer.

### **Assembling the bobbins**

Drawing FY-06

- Mount two plugs [31] with two-components glue inside a stem [30]. Take care that the 2 x 45° chamfers are facing inward and that the outer surfaces of the plugs are at the same level as the outer ends of the stem.
- Mount a loop of artificial silk yarn [32] in the groove of a pulley [29].
- Mount this pulley with two-components glue around a stem [30].
- Mount a pulley without a groove around the other end of the stem with two-components glue.
- Take care that the outer surfaces of the pulleys are at the same level as the outer ends of the stem.

## **11.6 Assembling the fine yarn spinning mechanism**

### **Mounting the wooden bearing in the front flyer support**

Drawing FY-03

- Position the wooden bearing [7], with the 4 x 45° chamfers facing forward, inside the front flyer support [2] on the spinning mechanism base.
- Fix the wooden bearing with an M6 round head wood bolt [8], a nut [9] and a washer [10] to the front flyer support.
- Tighten the bolt and nut that much, so the head of the bolt is nearly at the same level as the top surface of the wooden bearing.

## **Mounting the brake mechanism in the guide**

Drawing FY-03

- Insert the thread end of the regulator [11] from the rear through the square hole in the guide [3] on the spinning mechanism base. Do not insert the thread end through the  $\varnothing$  6.5 hole in the guide yet.
- Put a washer [10] over the thread end.
- Put the spring [12] over the thread end against the washer.
- Insert the thread end through the  $\varnothing$  6.5 hole in the guide.
- Turn the regulator nut [13] on the thread end. Take care that the step on the nut is facing towards the guide.

## **Mounting the rear flyer support**

Drawing FY-04

- Mount the piece of leather [17] in the rear flyer support [16] (or [16a]). Take care that the  $\varnothing$  7 holes in the piece of leather are in line with the  $\varnothing$  7 holes in the rear flyer support.
- Secure the piece of leather in the rear flyer support with an M6 bolt [18], washer [19] and nut [20].
- Tighten the nut just enough, so that it will not get loose during the normal operation of the charkha.
- Mount the rear flyer support tightly by hand to the rear support [5] of the spinning mechanism base with an M8 bolt [21], nut [23] and washers [22].
- Insert the spindle [26] of the flyer in the rear flyer support, below the M6 bolt.
- Place the front part of the orifice [24] of the flyer on top of the wooden bearing [7] inside the front flyer support [2].
- Check if the spindle of the flyer is parallel to and in line with the main support [1] of the spinning mechanism base. Correct if necessary by adjusting the position of the rear flyer support.
- Secure the rear flyer support by turning the M8 bolt and nut tightly.

## **Mounting the fine yarn spinning mechanism**

Drawing FY-01

Drawing CF-01

- Mount the two adjustment nuts [15] on the protruding thread ends of the M12 bolt [4].
- Turn both adjustment nuts in a position close to the main support [1].
- Insert the thread ends in the two holes in the cross beam of the charkha frame. Take care that the front flyer support [2] is in front.

- Adjust the position of the spinning mechanism until the main support is parallel to the cross beam of the charkha frame.
- Mount M12 nuts [33] on the thread ends at the bottom of the cross beam.
- Turn on these counter nuts until they touch the cross beam.
- Secure the spinning mechanism by turning on the adjustment nuts tightly.

### **Mounting the flyer and the bobbin**

Drawing FY-01

- Insert the spindle [26] of the flyer without force into the hole in the plug [31] of the bobbin.
- Rotate and align the bobbin on the spindle until it fits.
- Place the spindle end in the piece of leather [17] below the bolt [18] of the rear flyer support [16] (or [16a]). Take care that the spindle end is not placed above the bolt.
- Place the orifice [24] with pulley on top of the wooden bearing [7] inside the front flyer support [2].

### **Mounting the brake mechanism**

Drawing FY-01

- Adjust the position the regulator [11] with the regulator nut [13] until the spring [12] is compressed to a length of 20mm. Take care that the spring is not completely compressed or released.
- Tie the brake [34] (a piece of artificial silk yarn), through the  $\varnothing$  5 hole, to the main support [1] of the spinning mechanism base.
- Guide the brake over the groove in the pulley [29] of the bobbin along the hook [6] welded to the main support (refer to drawing FY-01 section A-A).
- Tie the brake tightly, through the  $\varnothing$  4.2 hole, to the regulator of the brake mechanism. Take care that the brake is tied in such a way, that there is no tension in the brake when the spring is completely released.

# 12 Construction of a rewind spindle

## [1] Spindle

Drawing RS-02

- Cut the piece of MS round  $\varnothing$  6 into 500mm length. Take care that a properly straight polished bar of MS round  $\varnothing$  6 is used.
- Taper one end into  $30 \times 4^\circ$ .
- Brake the edges at both sides.

## [2] Wooden disk

Drawing RS-02

- Use a piece of hard wood to prepare the wooden disk.
- Turn the outer diameter into correct dimensions on a lathe.
- Drill, in a lathe, a hole of  $\varnothing$  6.5 in the centre of the wooden disk.
- Brake the edges of the hole and the outer diameter.

## [3] Iron body

Drawing RS-02

- Cut the piece of MS round  $\varnothing$  32 into 58mm length.
- Smooth both sides on a lathe to get a piece of 56mm length with smooth surfaces.
- Measure the inside diameter of the PVC pipe, used for the body [6], with a sliding gauge.
- Turn of the step of the iron body that has to be mounted in the PVC body. Check and correct, if necessary, the diameter of the step until the step gently fits inside the PVC body.
- Chamfer the edge into  $2 \times 45^\circ$ .
- Release the piece from the chuck and mount it the other way around again in the chuck. Take special care that the piece is running correctly, since all the faces of the iron body should be exactly concentric.
- Turn of the step of  $\varnothing$  15.8 into 23mm length.
- Brake the edges.

- Drill the hole of  $\varnothing 6$  in the centre of the iron body. Check if the spindle [1] can be mounted in the hole easily.
- Mark the position of the  $\varnothing 4.2$  hole and drill the hole in the iron body.
- Countersink the edge of the hole.
- Tap M5 threading in the hole.

### **[5] Pulley (2)**

Drawing RS-02

- Use pieces of hard wood to prepare the two pulleys.
- Turn the outer diameter with the groove into correct dimensions on a lathe. Prepare a special cutting tool in the shape of the groove if a number of pulleys have to be made.
- Measure the outside diameter of the PVC pipe, used for the body [6], with a sliding gauge.
- Drill, in a lathe, a hole of  $\varnothing 23$  in the centres of the pulleys and turn this hole out until the body [6] fits gently inside the hole. Check and correct the size of the hole if necessary.

### **[6] PVC body**

Drawing RS-02

- Cut the piece of  $\varnothing 25$  PVC pipe into 199mm length.
- Smooth both sides on a lathe to get pieces of 197mm length with smooth surfaces.
- Measure the inside and the outside diameters of the PVC pipe with a sliding gauge. These measurements are needed to prepare the iron body [3] and the pulleys [5].

### **[7] Plug**

Drawing RS-02

- Use a piece of hard wood to prepare the plug.
- Measure the inside diameter of the PVC pipe, used for the PVC body [6], with a sliding gauge.
- First turn of the outer diameter until the plug fits gently inside the PVC body. Check and correct the outer diameter if necessary.
- Chamfer the edge of one side into  $2 \times 45^\circ$ .
- Drill, in a lathe, holes of  $\varnothing 6.5$  in the centre of the plug.
- Brake the edges of the hole.

### **Assembling the rewind spindle**

Drawing RS-02

- Mount the plug [7] with two-components glue inside the PVC body



- [6]. Take care that the 2 x 45° chamfers are facing inward and that the outer surface of the plug is at the same level as the outer end of the PVC body.
- Mount the two pulley [5] on both ends of the PVC body with two-components glue. Take care that the outer surfaces of the pulleys are at the same level as the outer ends of the PVC body.
  - Mount the iron body [3] with two-components glue inside the PVC body. Take care that the PVC body touches the  $\varnothing$  32 step.
  - Insert the tapering end of the spindle [1] in the plug and through the iron body.
  - Check the length of 33mm of the spindle that protrudes out of the plug.
  - Secure the spindle inside the iron body with an M5 slotted clamping set screw [4].
  - Mount the wooden disk [2] on the spindle in front of the iron body.

## 12.1 Mounting the rewind spindle

### Mounting the rewind spindle on a medium yarn spinning mechanism

Drawing RS-01  
Drawing MY-01

- Release the tension of the brake mechanism of the medium yarn spinning mechanism completely with the regulator nut.
- Hang the driving belt over the main support of the spinning-mechanism behind the rear flyer support.
- Remove the wooden disk from the rewind spindle.
- Insert the spindle from rear to front under the brake on top of the front flyer support.
- Place the  $\varnothing$  15.8 step of the iron body on top of the wooden bearing and put the brake over it. Do not tighten the brake mechanism.
- Lift the rewind spindle until the iron body can be pulled forward over the wooden bearing to place the rear spindle end on the piece of leather under the bolt of the rear flyer support.
- Place the  $\varnothing$  15.8 step of the iron body on top of the wooden bearing and tighten the brake mechanism a little in order to prevent the rewind spindle from jumping out off the wooden bearing. Take care that the rotation of the spindle is not broken.
- Mount the wooden disk on the spindle against the iron body in front of the front flyer support.
- Mount the driving belt over the rear pulley and the driving wheel.

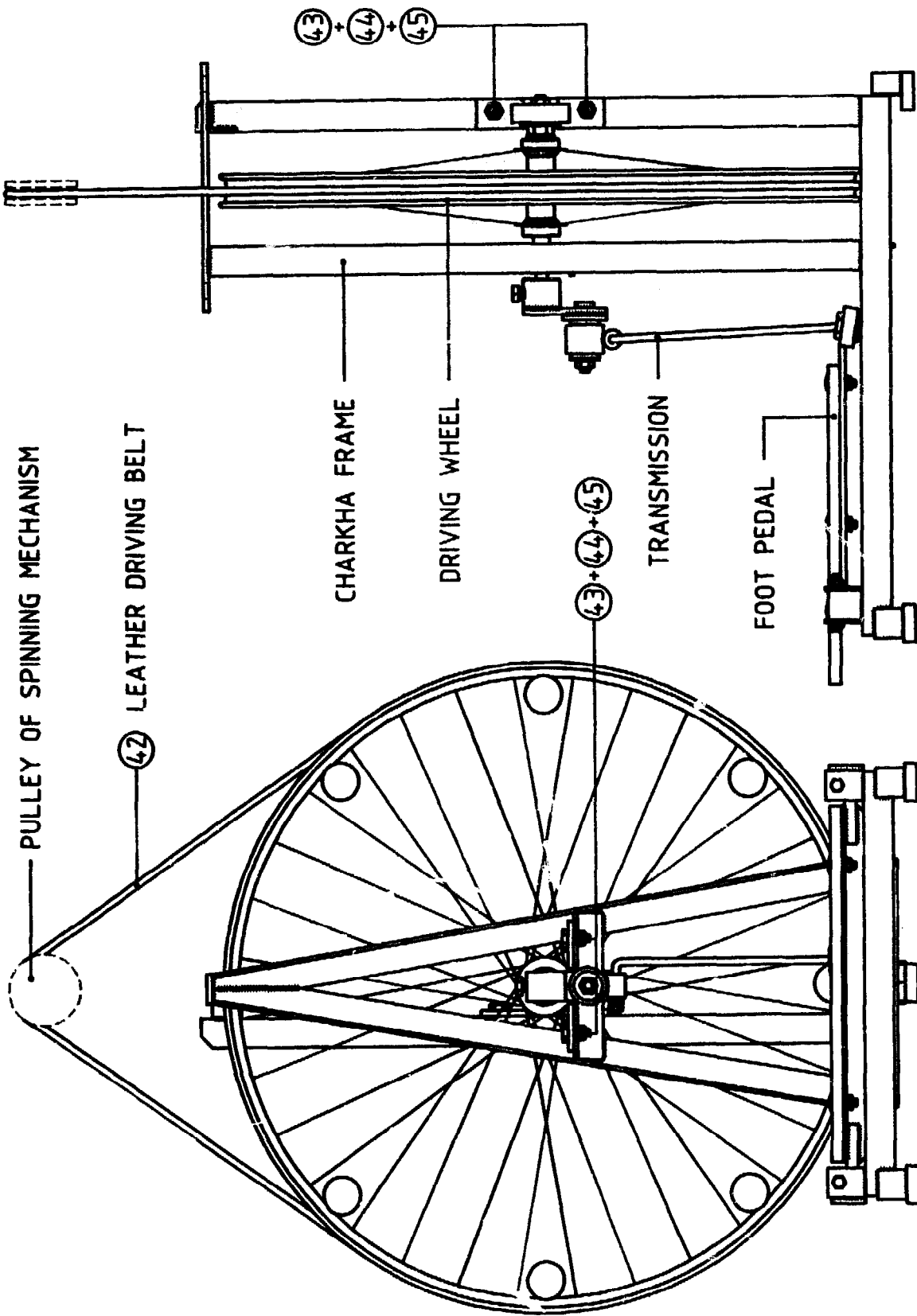
## **Mounting the rewind spindle on a fine yarn spinning mechanism**

Drawing RS-01

Drawing FY-01

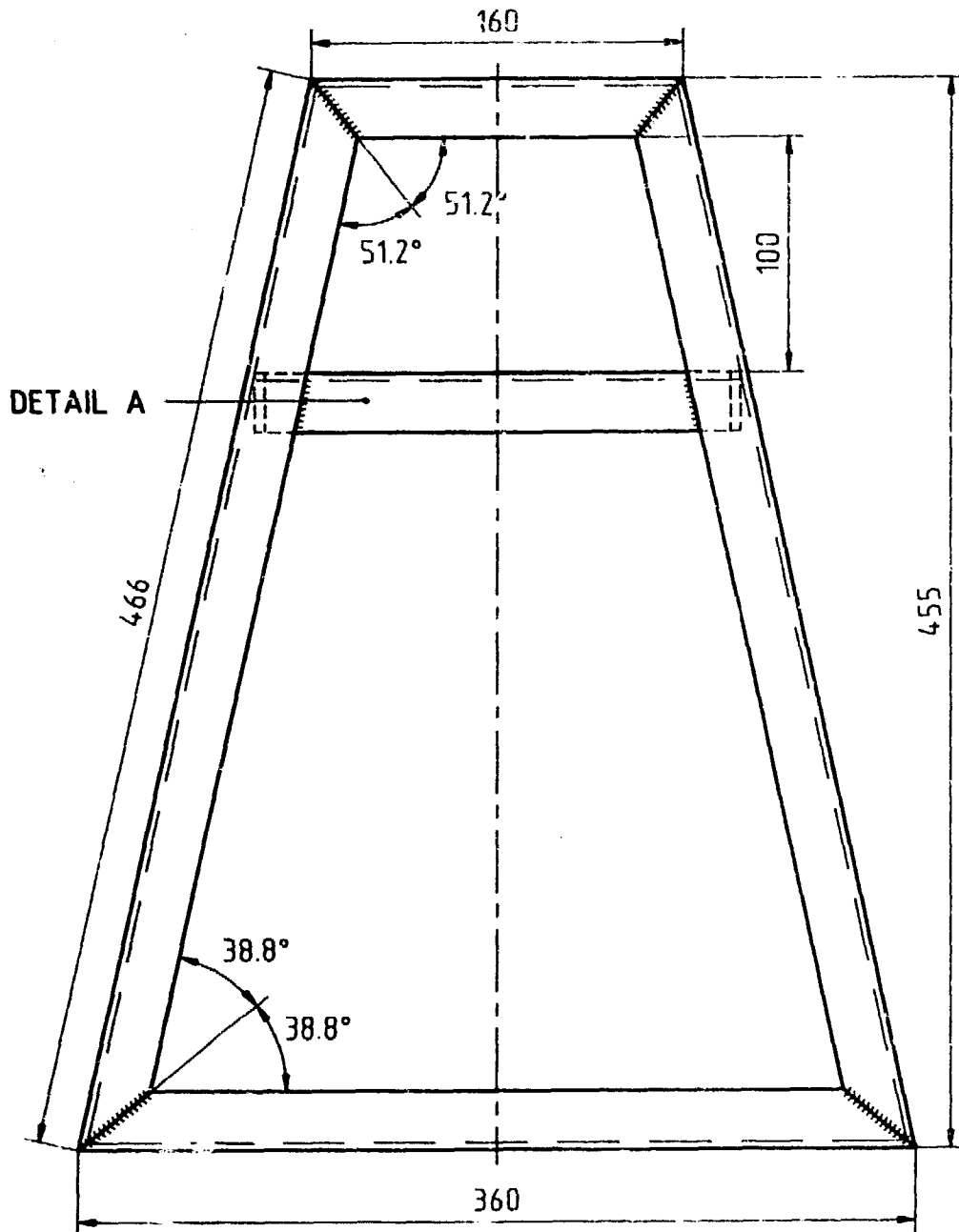
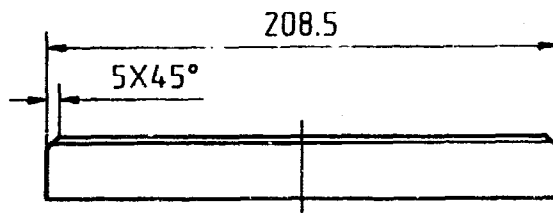
- Hang the leather driving belt over the main support of the spinning-mechanism in front of the front flyer support.
- Remove the wooden disk from the rewind spindle.
- Place the spindle end on the piece of leather under the bolt of the rear flyer support.
- Place the  $\varnothing$  15.8 step of the iron body on top of the wooden bearing in the front flyer support.
- Put a small piece of wood in the piece of leather under the bolt of the rear flyer support on top of the spindle end to prevent the spindle end from jumping inside the rear flyer support.
- Mount the wooden disk on the spindle against the spindle body in front of the front flyer support.
- Mount the driving belt over the front pulley and the driving wheel.

# **13 Construction drawings**



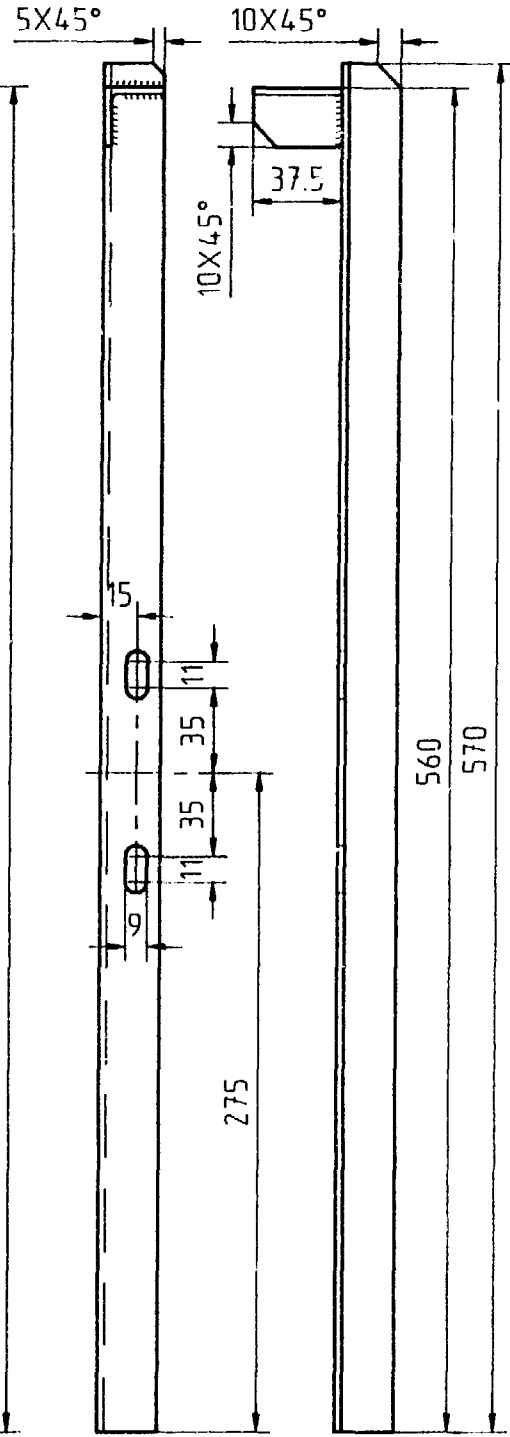
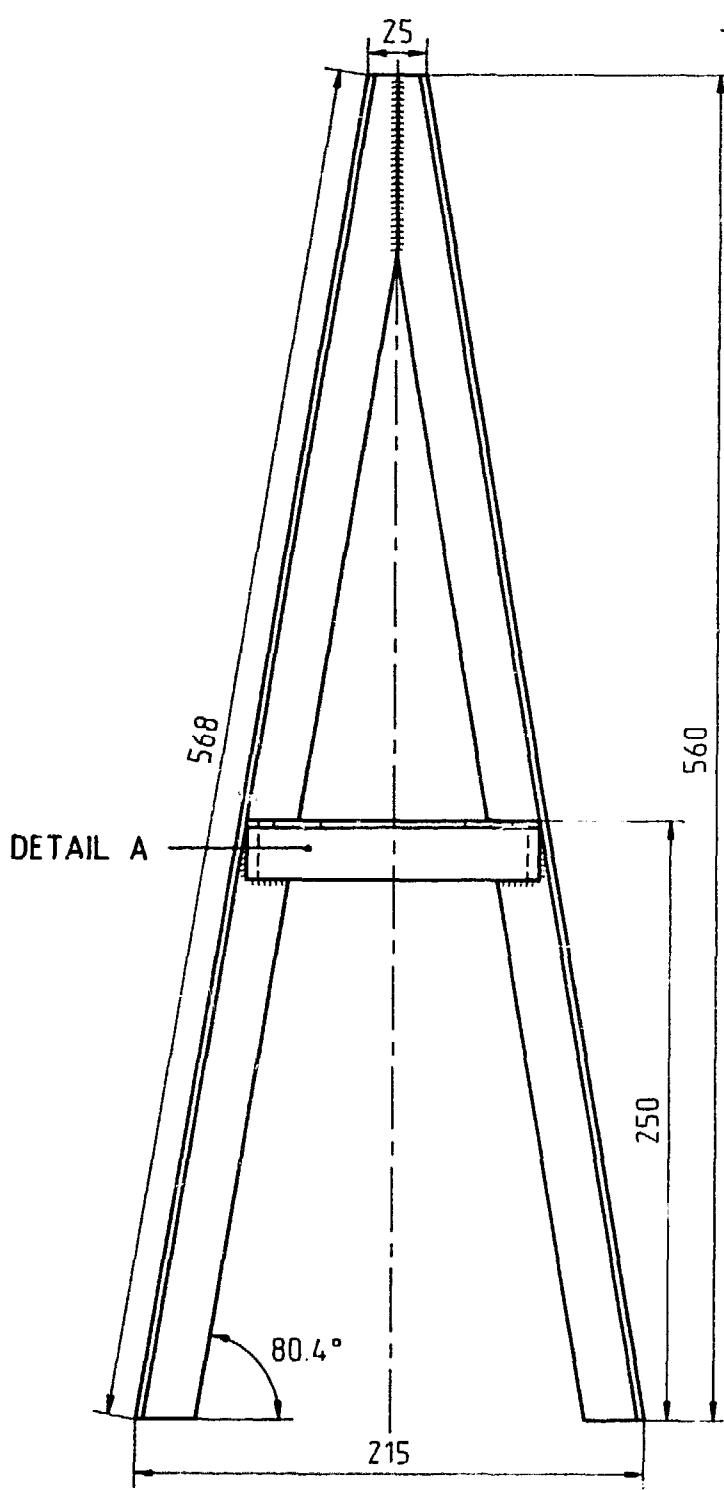
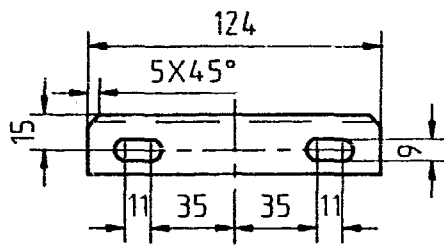
Drawing CF-01	Date: 01/05/91	Assembled CHARKHA FRAME with
Scale: 1 : 5	Units: mm	Driving Wheel, Foot Pedal and Transmission
TOOL Amsterdam Holland		MEDLERI CHARKHA

DETAIL A: Front view



① GROUNDFRAME

Drawing CF-02	Date: 01/05/91	GROUNDFRAME
Scale: 1 : 3	Units: mm	CHARKHA FRAME
TOOL Amsterdam Holland		MEDLERI CHARKHA

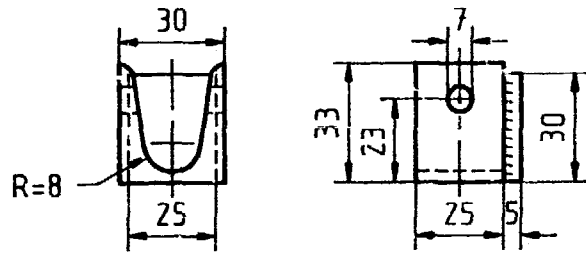


DETAIL A

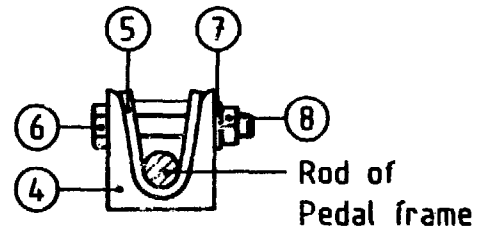
② FRONT LEGS

③ REAR LEG

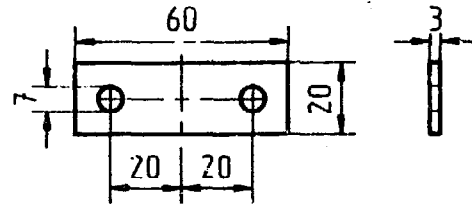
Drawing CF-03	Date: 01/05/93	FRONT and REAR LEGS
Scale: 1 : 3	Units: mm	CHARKHA FRAME
TOOL Amsterdam Holland	MEDLERI CHARKHA	



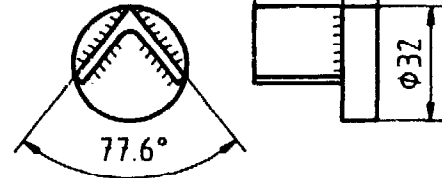
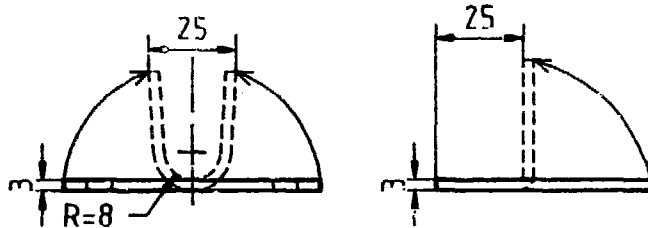
④ PEDAL HINGE



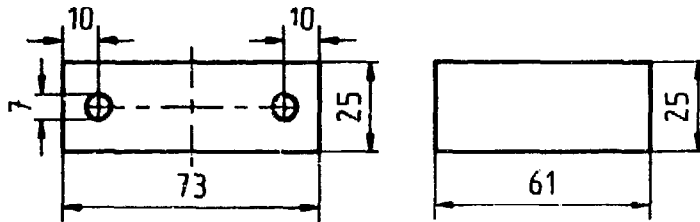
ASSEMBLED PEDAL HINGE



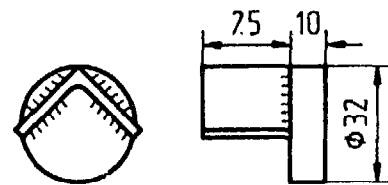
⑤ PIECE OF LEATHER



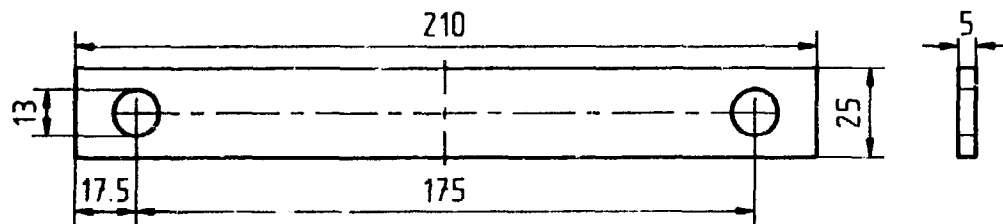
⑨ FRONT SUPPORT



④a PEDAL HINGE (Alternative design)

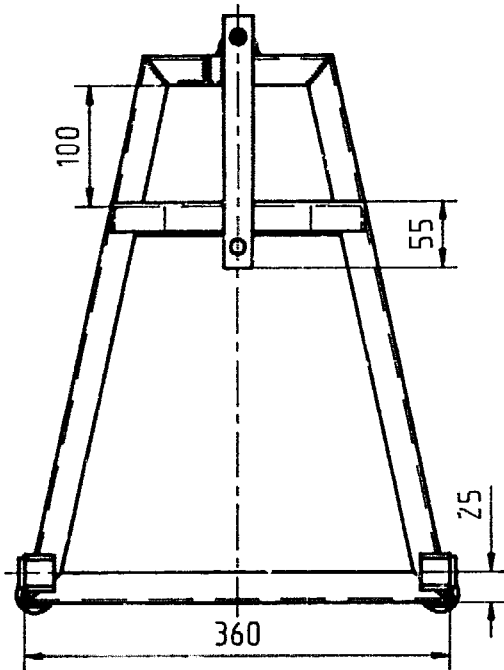


⑩ REAR SUPPORT



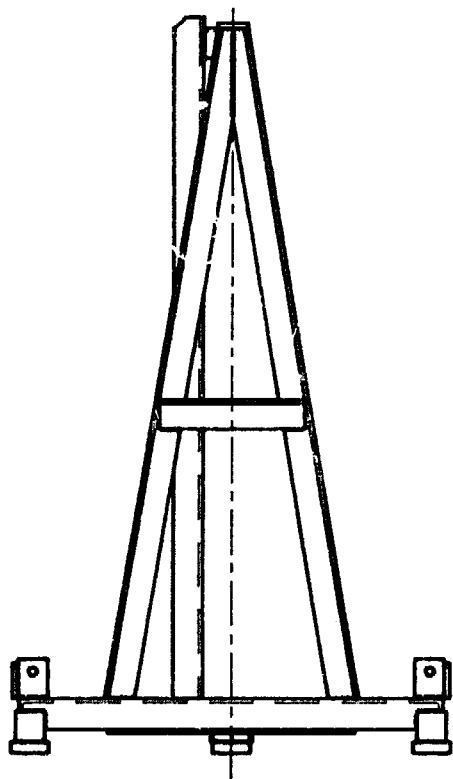
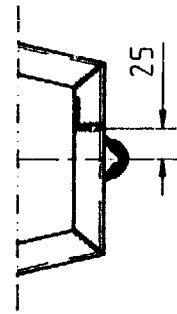
⑪ CROSS BEAM

Drawing CF-04	Date: 01/05/91	Pedal Hinges, Supports and Cross beam
Scale: 1 : 2	Units: mm	CHARKHA FRAME
TOOL Amsterdam Holland		MEDLERI CHARKHA

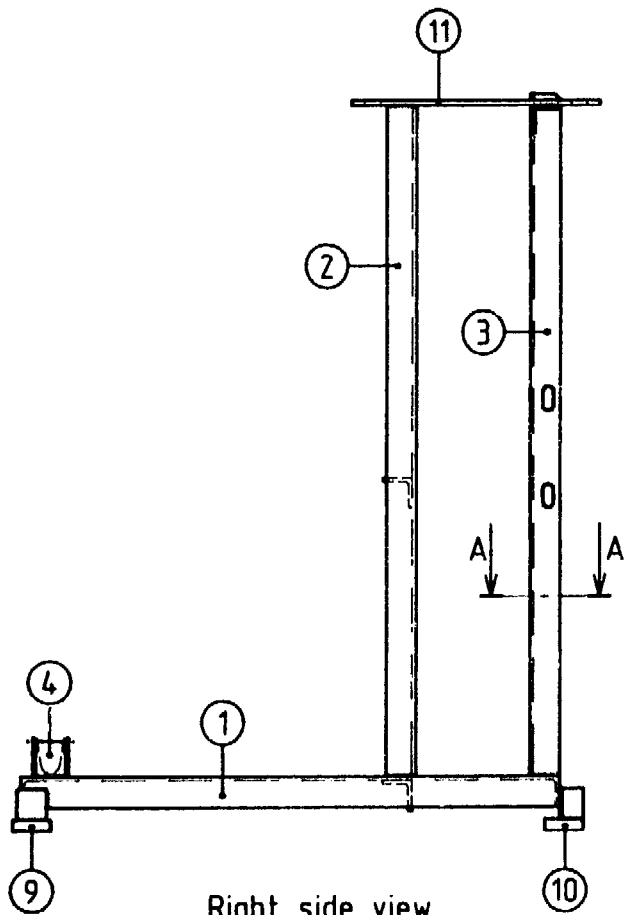


Top view

SECTION A-A



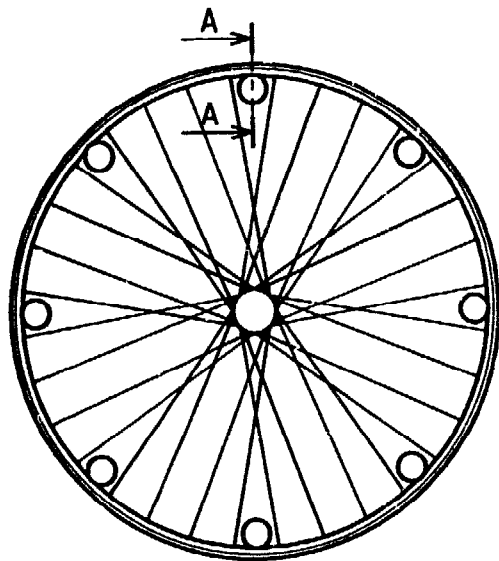
Front view



Right side view

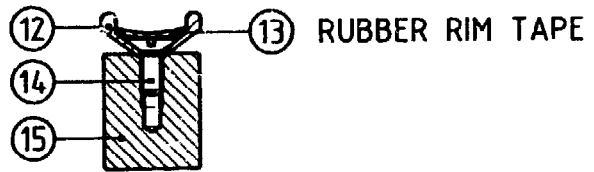
Drawing CF-05	Date: 01/05/91	CHARKHA FRAME
Scale: 1 : 6	Units: mm	
TOOL Amsterdam Holland		MEDLERI CHARKHA



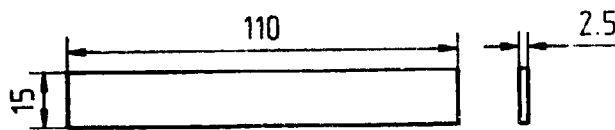


⑫ BICYCLE WHEEL with Weights

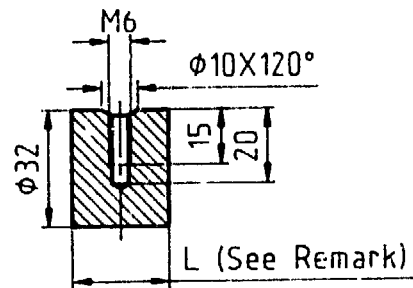
SECTION A-A: Mounted weight



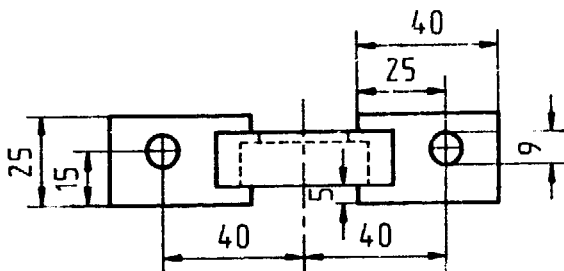
Remark regarding Length L:  
 For a Bicycle wheel with 32 spokes:  
 8 Weights with L=27  
 For a Bicycle wheel with 36 spokes:  
 6 Weights with L=36



⑬ PIECE OF LEATHER



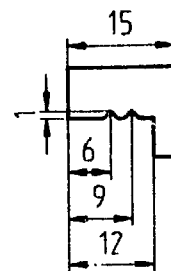
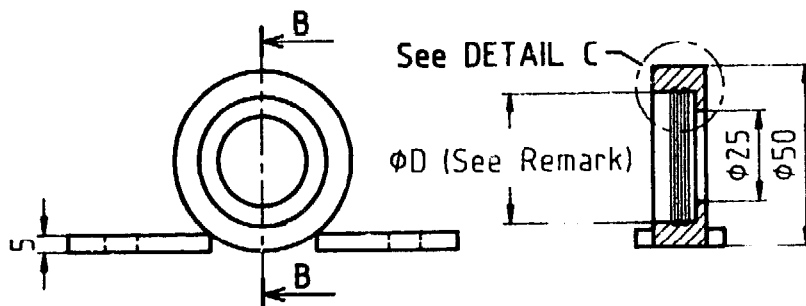
⑭ WEIGHT



Remark regarding diameter D:  
 For Rear ball-bearing 6200: D=34  
 For Front ball-bearing 6201: D=36

SECTION B-B

DETAIL C  
 (Scale 1:1)

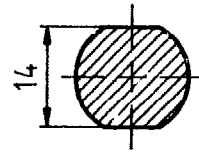
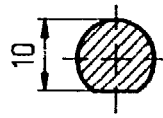


⑮ BEARING SUPPORT

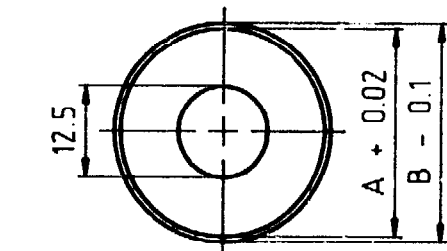
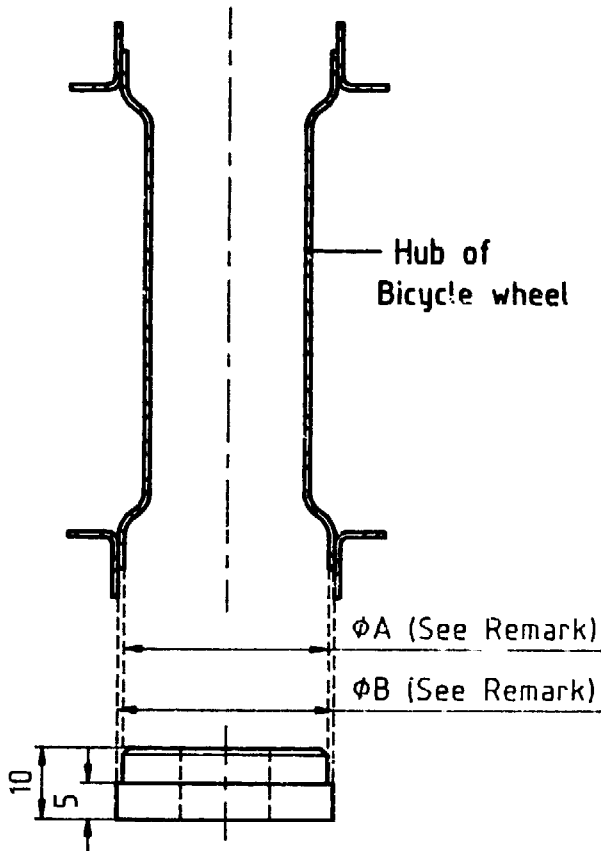
Drawing CF-06	Date: 01/05/91	BALL BEARING SUPPORTS and WEIGHTS
Scale: 1 : 2	Units: mm	DRIVING WHEEL
TOOL Amsterdam Holland		MEDLERI CHARKHA

SECTION A-A

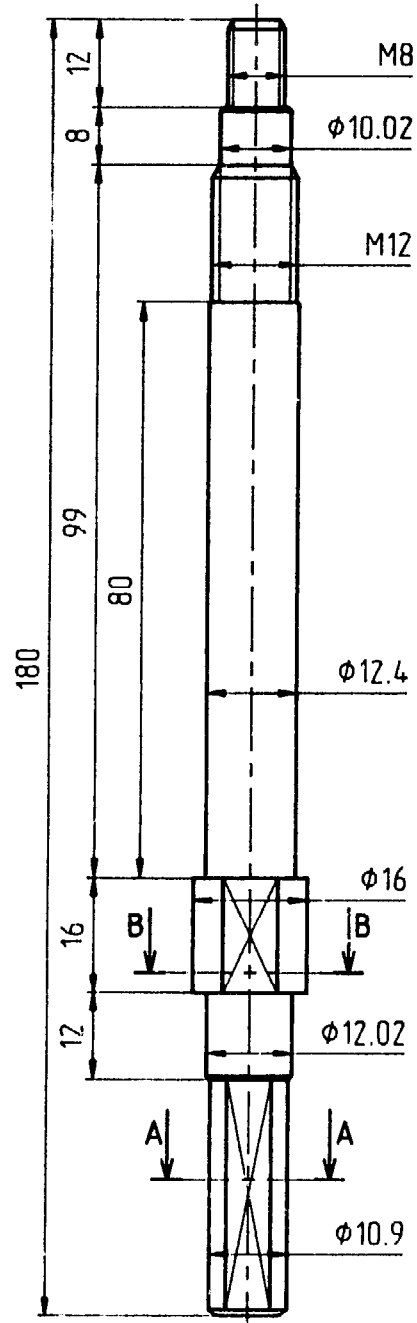
SECTION B-B



Remark regarding diameter A and B:  
 Measure diameter A and B inside the  
 Hub of the Bicycle wheel and make the  
 Bush according to these dimensions.

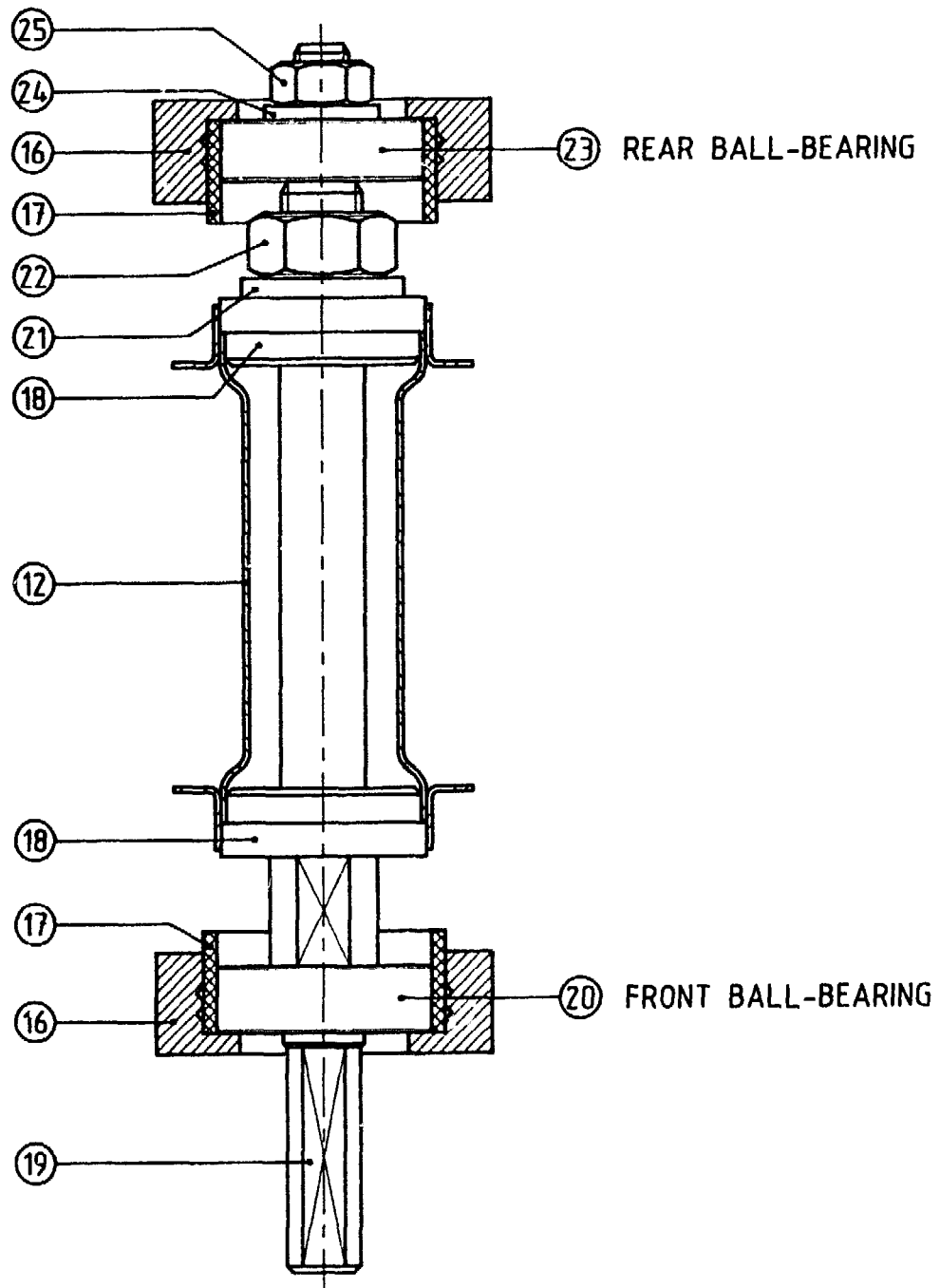


⑱ BUSH



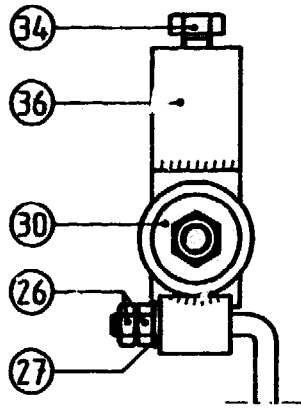
⑲ WHEEL SHAFT

Drawing CF-07	Date: 01/05/91	WHEEL SHAFT and BUSH
Scale: 1 : 1	Units: mm	DRIVING WHEEL.
TOOL Amsterdam Holland		MEDLERI CHARKHA

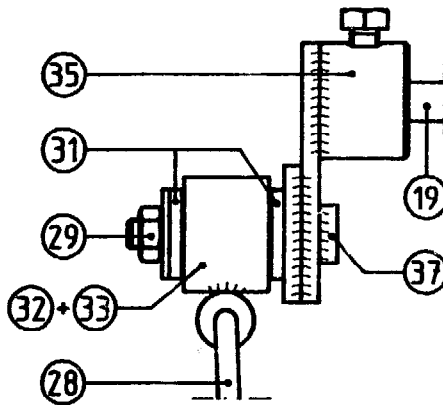


ASSEMBLED BICYCLE WHEEL HUB WITH  
SHAFT, BALL-BEARINGS AND BEARING SUPPORTS

Drawing CF-08	Date: 01/05/91	Assembled HUB with Shaft and BEARINGS
Scale: 1 : 1	Units: mm	DRIVING WHEEL
TOOL Amsterdam Holland		MEDLERI CHARKHA

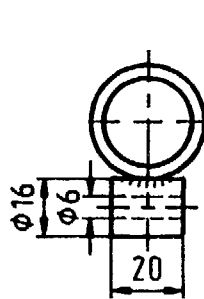


MOUNTED CRANK WITH  
CROSS-HEAD AND CONNECTING ROD

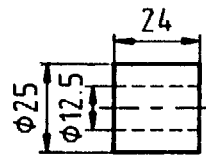
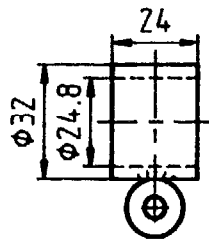


Part of  
Pedal Frame

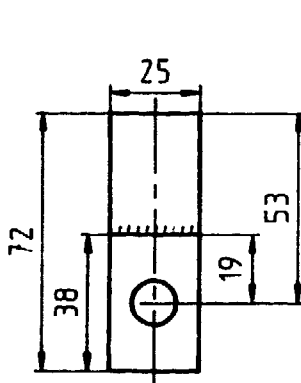
CONNECTING ROD  
MOUNTED IN FOOT PEDAL



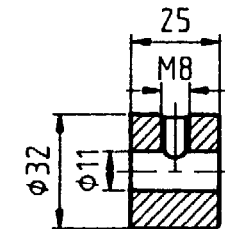
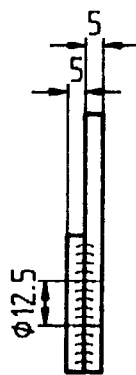
32 CROSS-HEAD



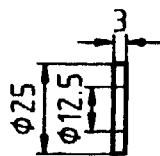
33 NYLON BUSH



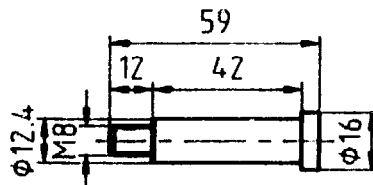
36 CRANK ARM



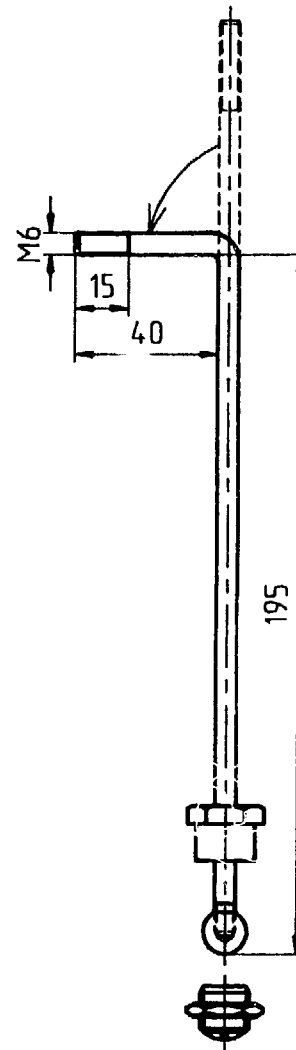
35 CRANK HEAD



31 LEATHER WASHER

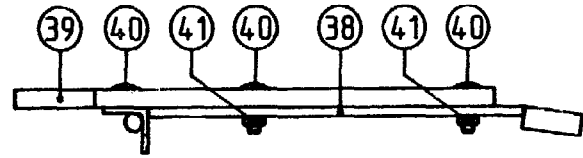


37 CRANK-PIN

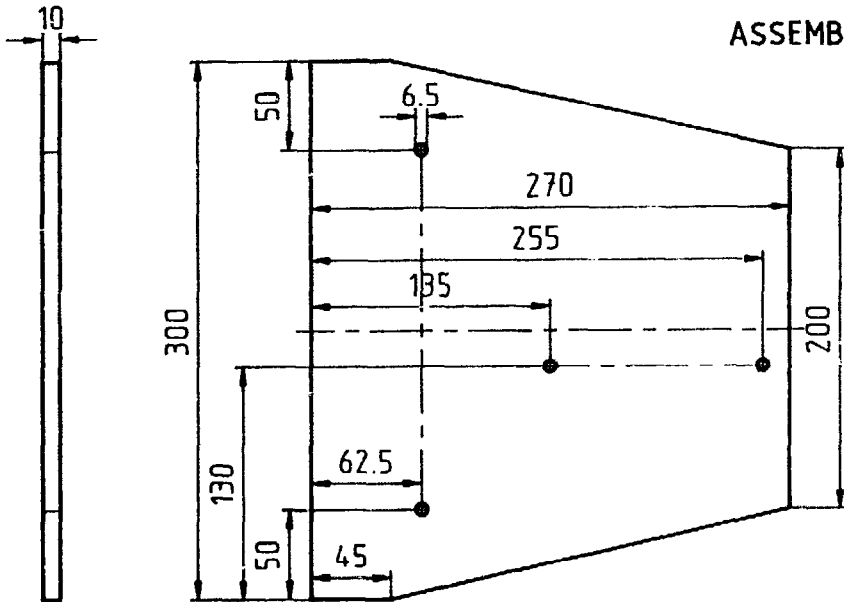


28 CONNECTING ROD

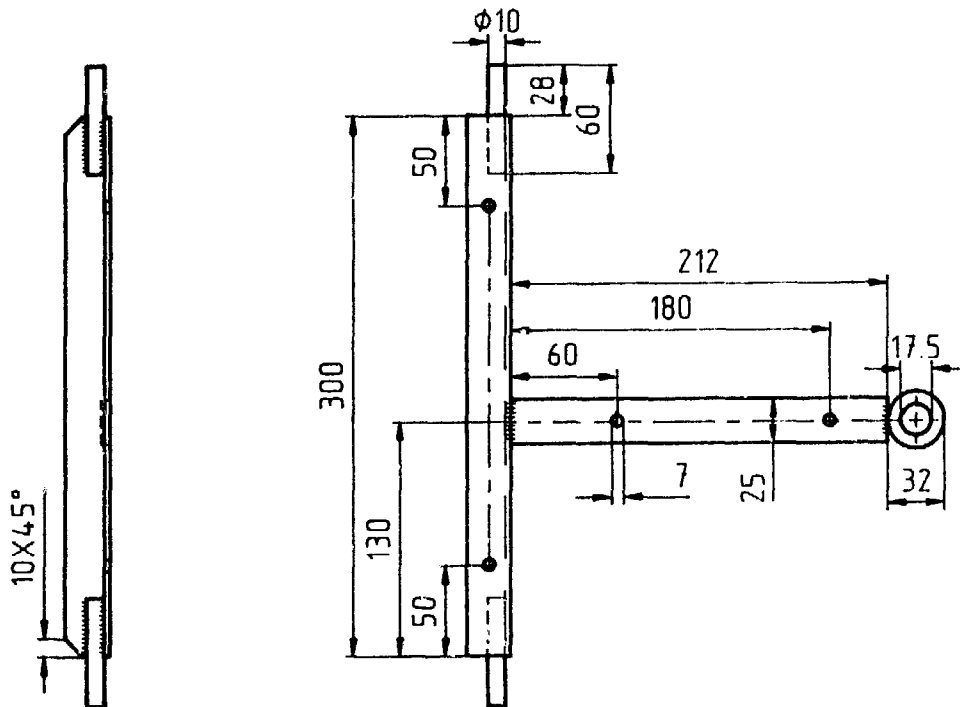
Drawing CF-09	Date: 01/05/91	CRANK, CROSS-HEAD and CONNECTING ROD
Scale: 1 : 2	Units: mm	TRANSMISSION
TOOL Amsterdam Holland		MEDLERI CHARKHA



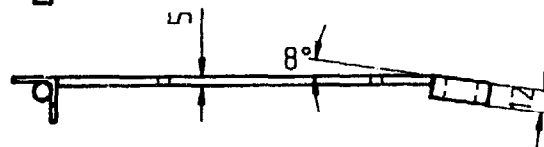
ASSEMBLED FOOT PEDAL



③ PEDAL COVER

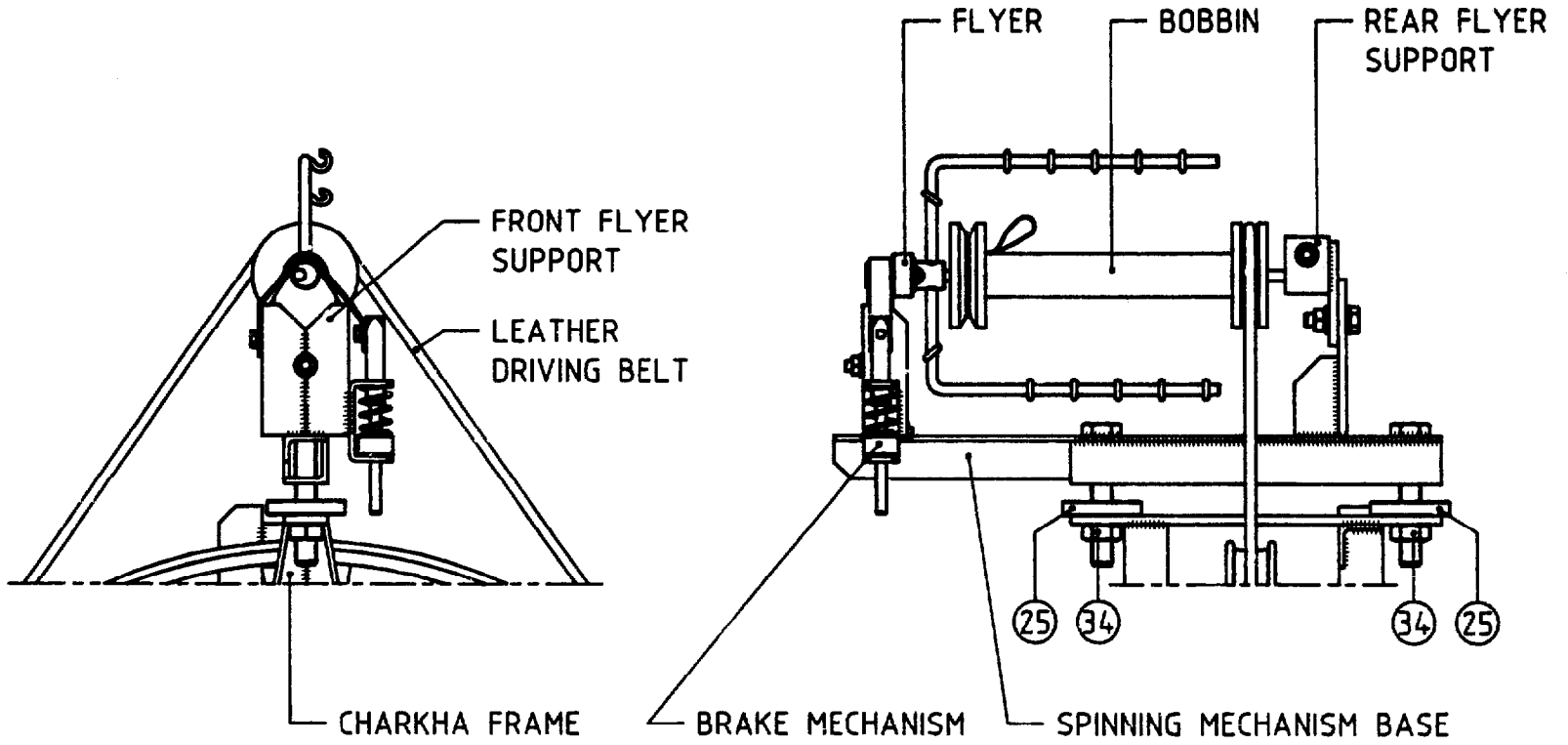


③ PEDAL FRAME

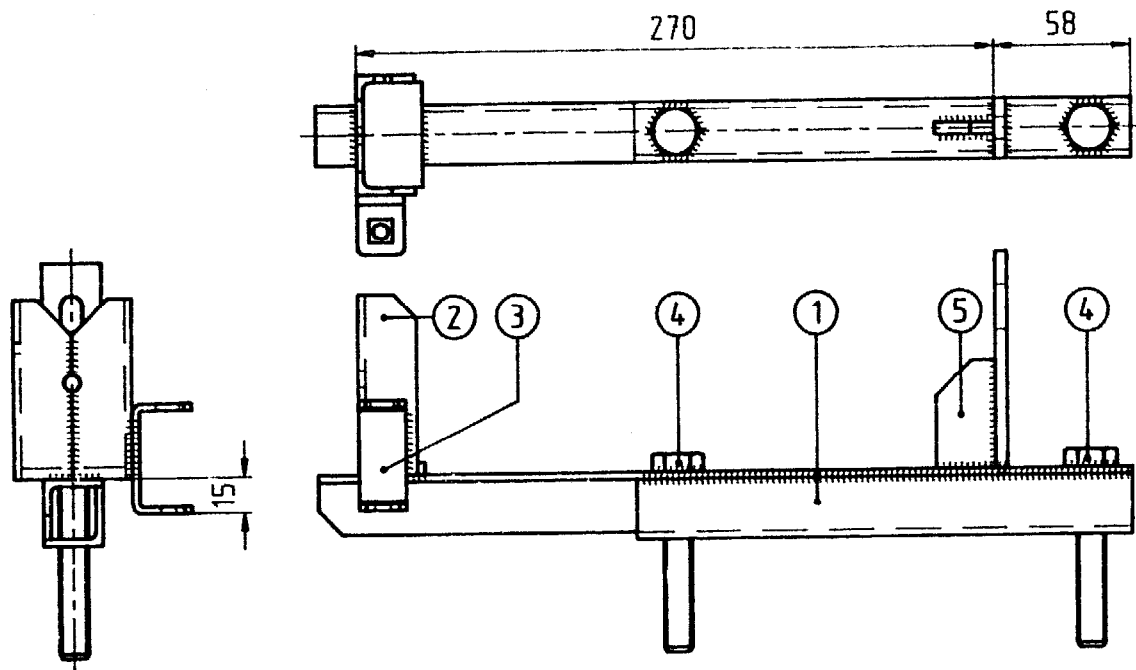


Drawing CF-10	Date: 01/05/91	PEDAL FRAME and PEDAL COVER
Scale: 1 : 4	Units: mm	FOOT PEDAL
TOOL Amsterdam Holland	MEDLERI CHARKHA	

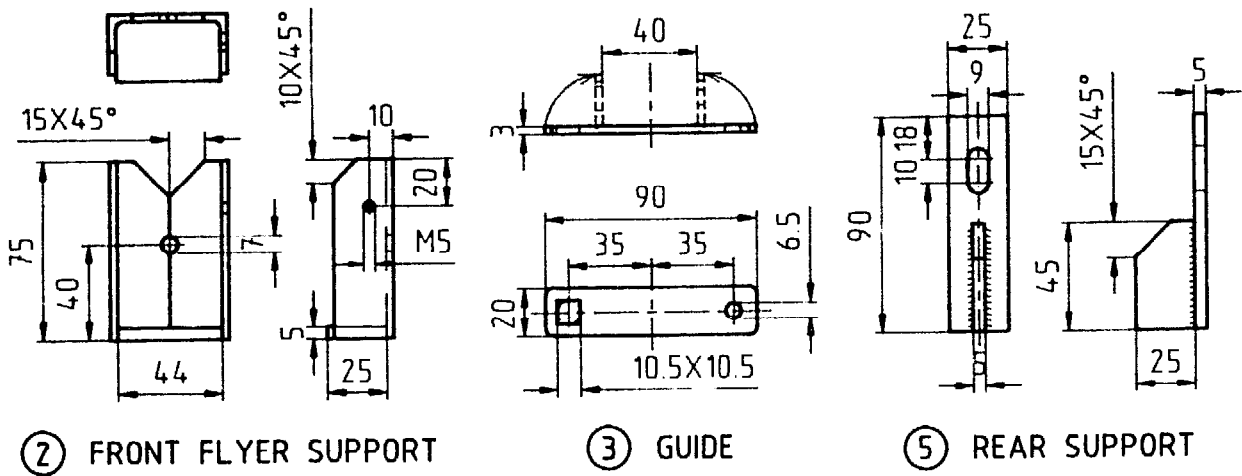
Drawing MY-01	Date: 01/05/91	Assembled SPINNING MECHANISM
Scale: 1 : 4	Units: mm	MEDIUM YARN SPINNING MECHANISM
TOOL Amsterdam Holland		MEDLERI CHARKHA



ASSEMBLED MEDIUM YARN SPINNING MECHANISM  
MOUNTED ON TOP OF A CHARKHA FRAME



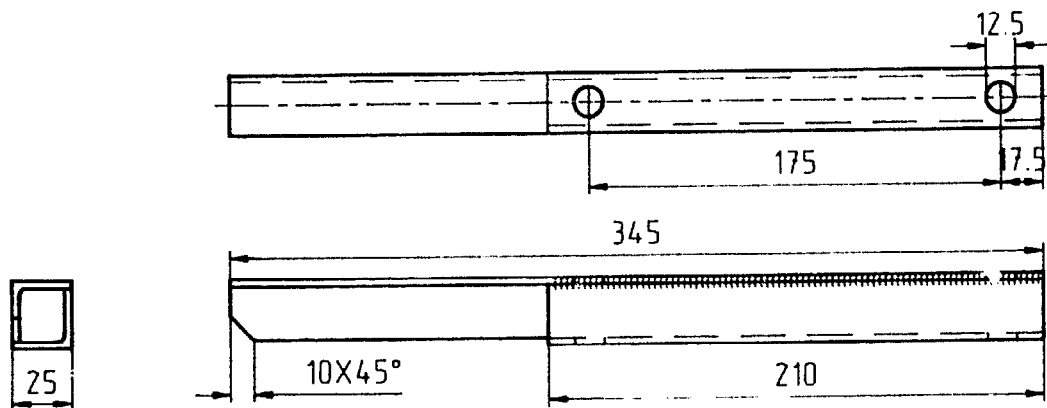
ASSEMBLED MEDIUM YARN SPINNING MECHANISM BASE



② FRONT FLYER SUPPORT

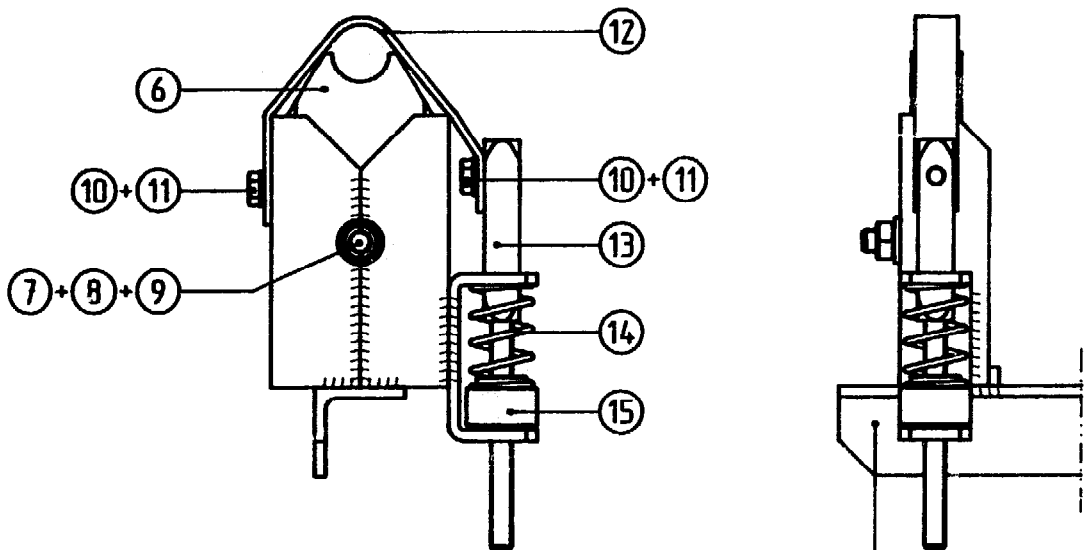
③ GUIDE

⑤ REAR SUPPORT



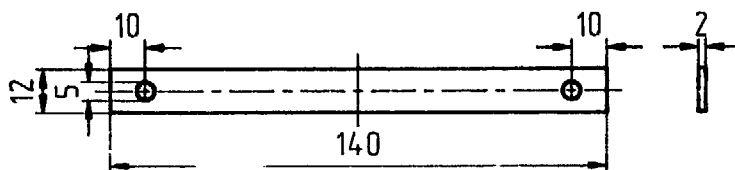
① MAIN SUPPORT

Drawing MY-02	Date: 01/05/91	SPINNING MECHANISM BASE
Scale: 1 : 3	Units: mm	MEDIUM YARN SPINNING MECHANISM
TOOL Amsterdam Holland		MEDLERI CHARKHA

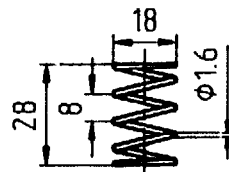
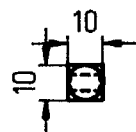
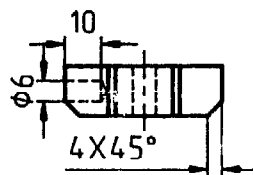


SPINNING MECHANISM BASE

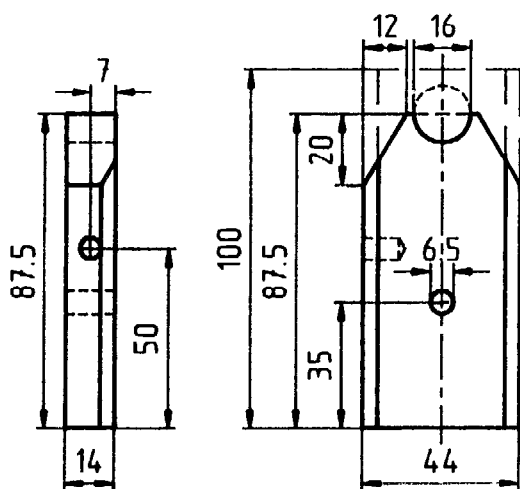
ASSEMBLED FRONT FLYER SUPPORT AND BRAKE MECHANISM



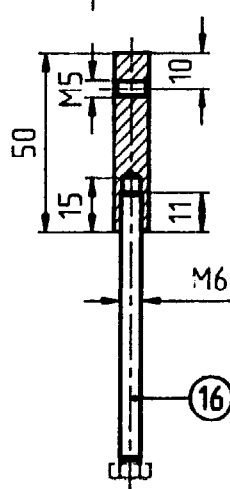
⑫ LEATHER BRAKE



⑭ SPRING



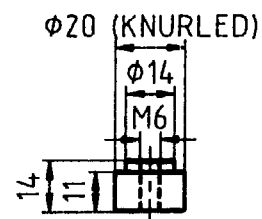
⑥ WOODEN BEARING



⑬ REGULATOR

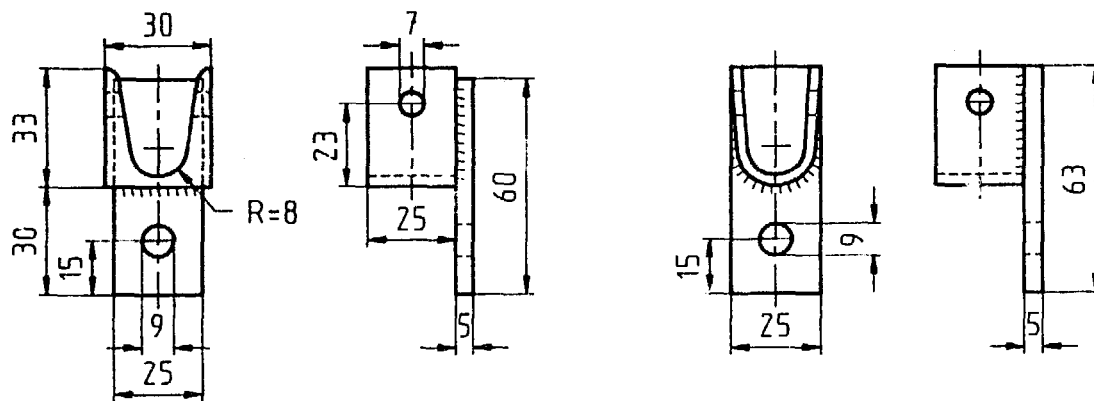
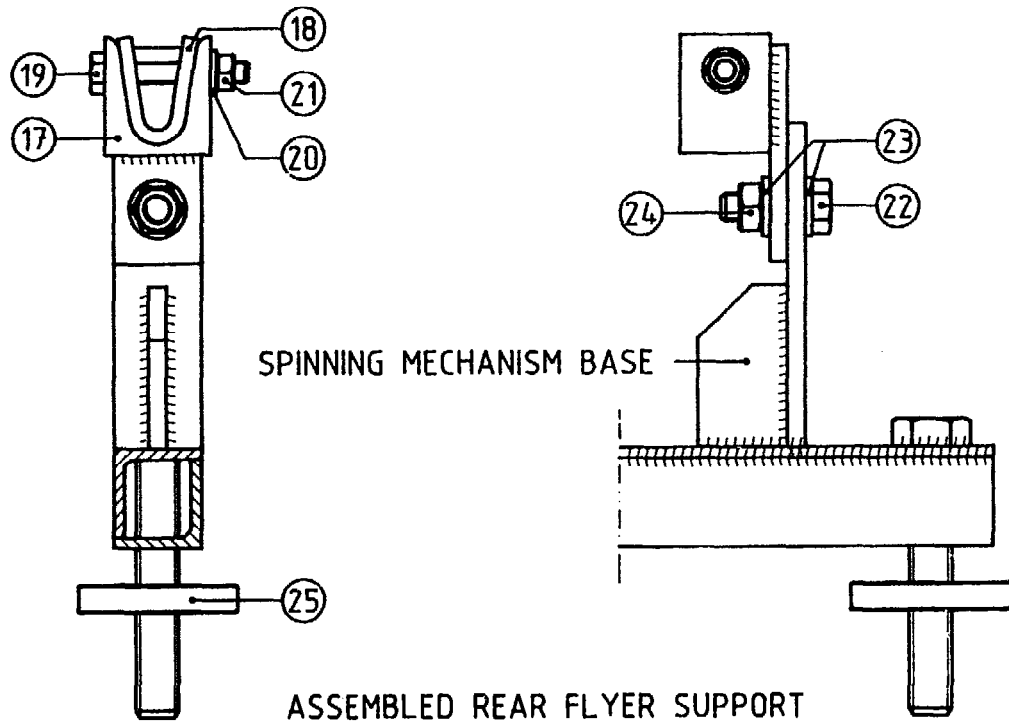


⑮ REGULATOR NUT

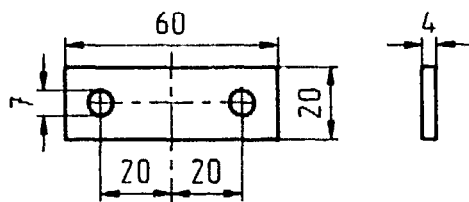


Drawing MY-03	Date: 01/05/91	Front Flyer Support and Brake Mechanism
Scale: 1 : 2	Units: mm	MEDIUM YARN SPINNING MECHANISM
TOOL Amsterdam Holland		MEDLERI CHARKHA

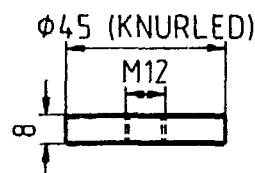




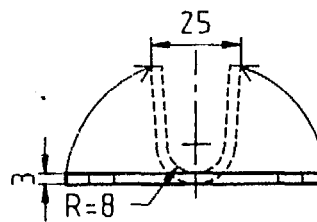
①⑦ REAR FLYER SUPPORT



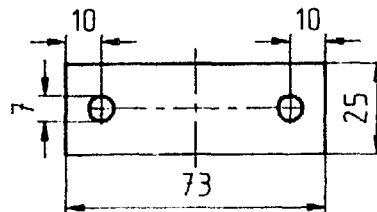
①⑧ PIECE OF LEATHER



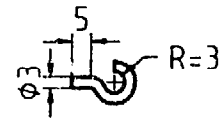
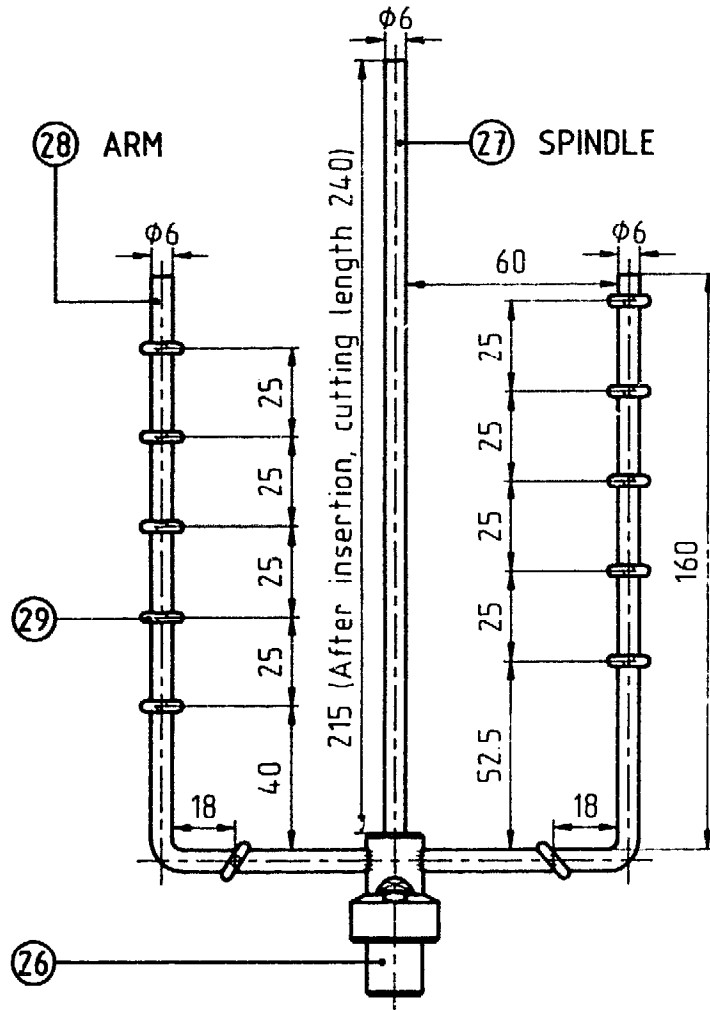
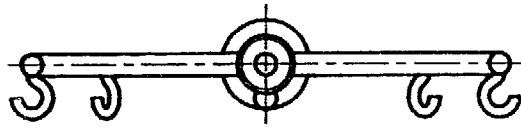
②⑤ ADJUSTMENT NUT



①⑦a REAR FLYER SUPPORT  
(Alternative design)

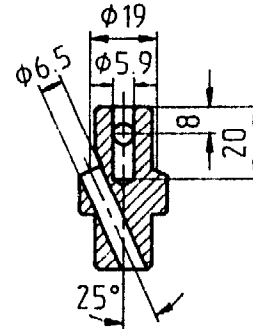


Drawing MY-04	Date: 01/05/91	Rear Flyer Support and Adjustment Nut
Scale: 1 : 2	Units: mm	MEDIUM YARN SPINNING MECHANISM
TOOL Amsterdam Holland		MEDLERI CHARKHA

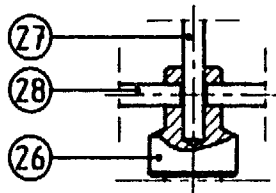


29 HOOK

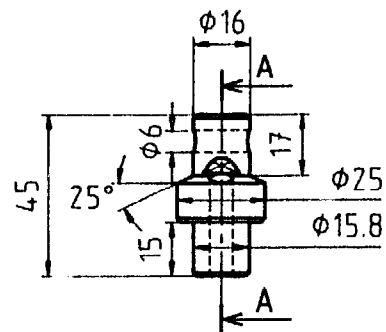
SECTION A-A



ASSEMBLED FLYER

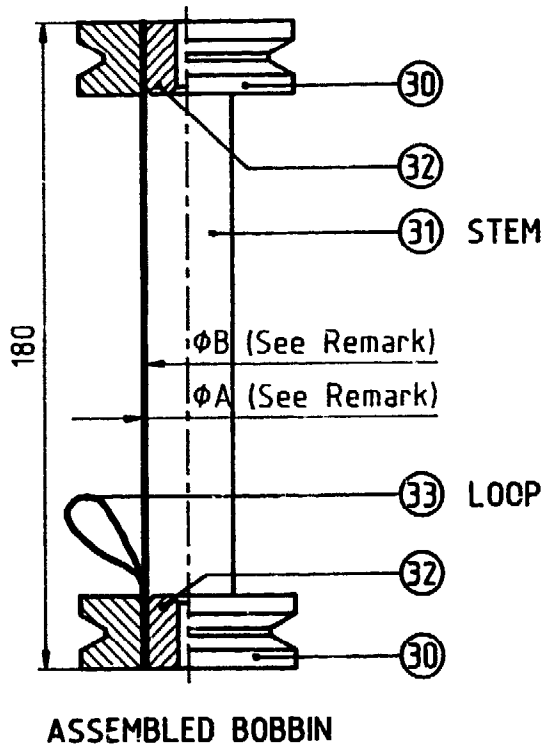


WELDING SPECIFICATION



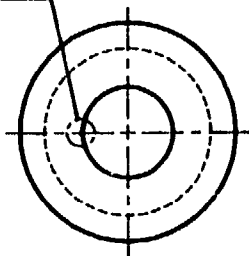
26 ORIFICE

Drawing MY-05	Date: 01/05/91	FLYER
Scale: 1 : 2	Units: mm	MEDIUM YARN SPINNING MECHANISM
TOOL Amsterdam Holland		MEDLERI CHARKHA

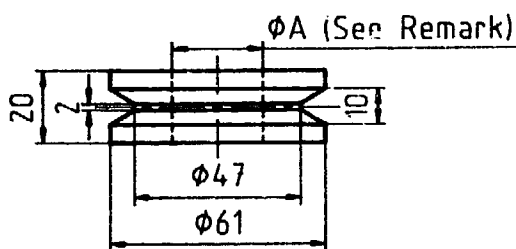


Remark regarding diameter A and B:  
 Measure diameter A and B of the pipe (used for the Stem) and make the Pulley and the Plug according to these dimensions.

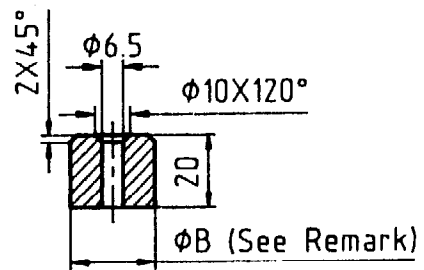
See DETAIL A



DETAIL A (Scale 5:1)  
 V-groove for LOOP



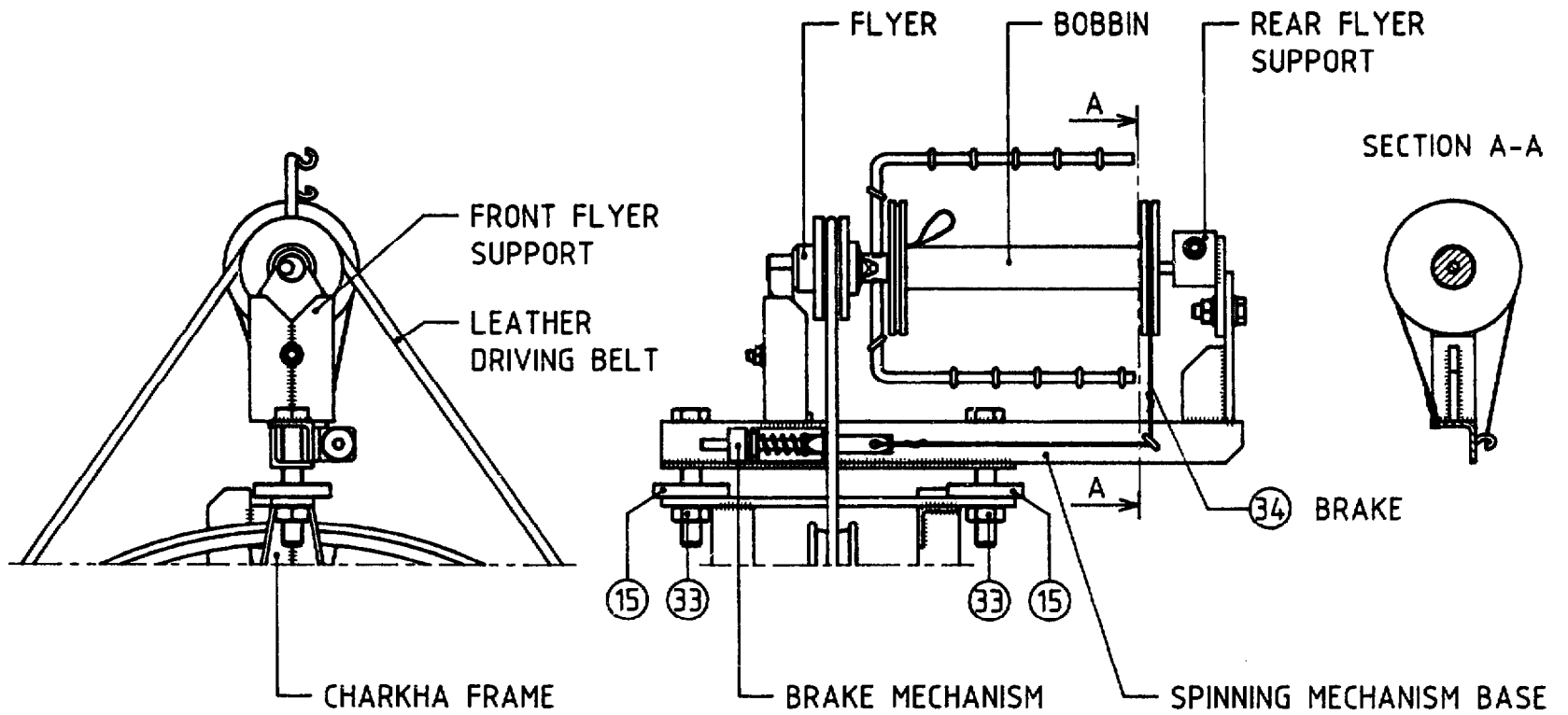
30 PULLEY



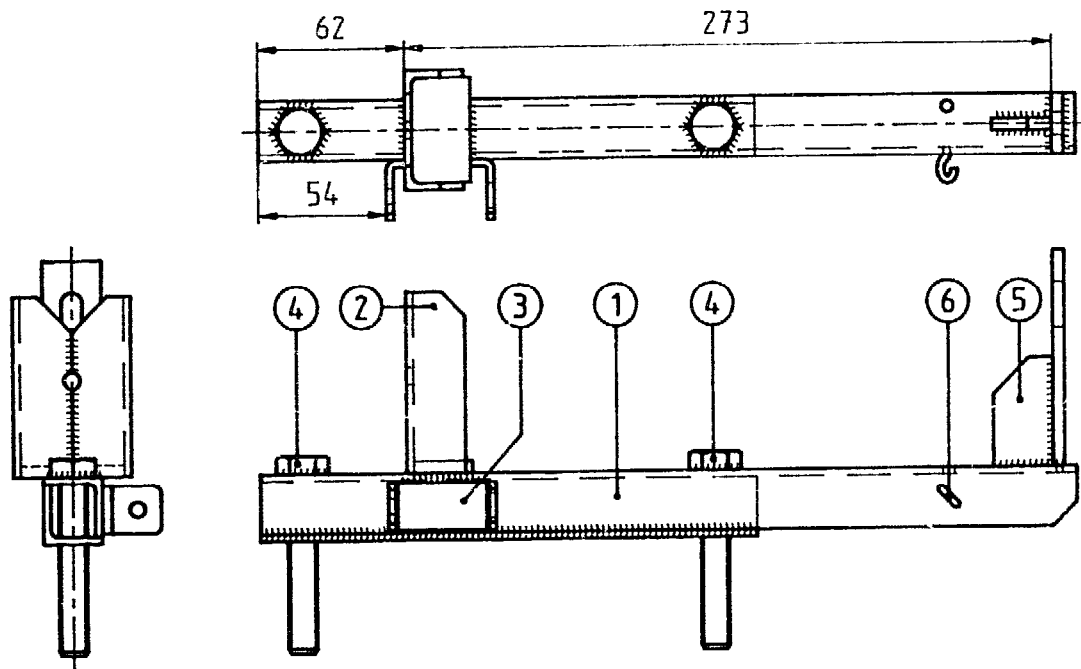
32 PLUG

Drawing MY-06	Date: 01/05/91	BOBBIN
Scale: 1 : 2	Units: mm	MEDIUM YARN SPINNING MECHANISM
TOOL Amsterdam Holland		MEDLERI CHARKHA

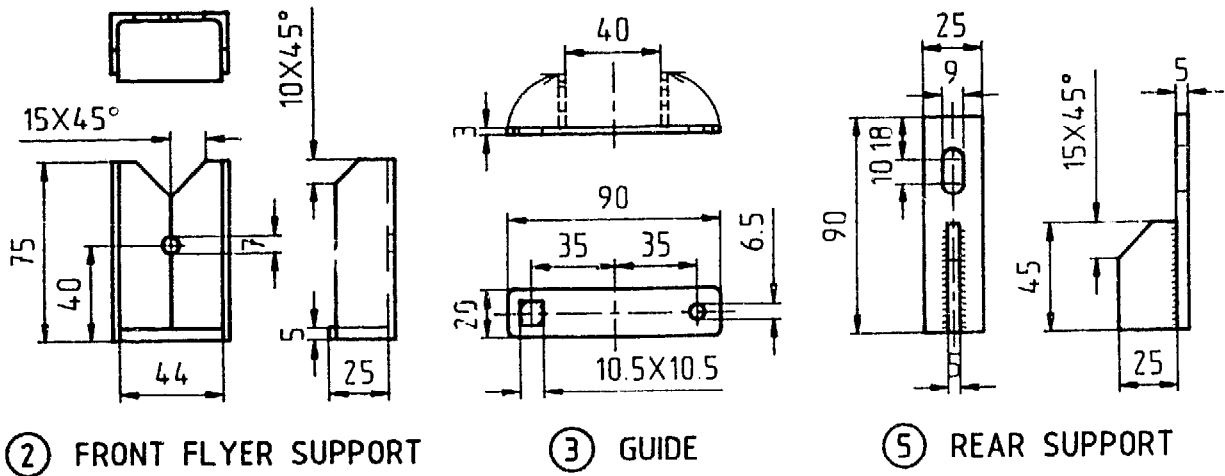
Drawing FY-01	Date: 01/05/91	Assembled SPINNING MECHANISM
Scale: 1 : 4	Units: mm	FINE YARN SPINNING MECHANISM
TOOL Amsterdam Holland		MEDLERI CHARKHA



ASSEMBLED FINE YARN SPINNING MECHANISM  
MOUNTED ON TOP OF A CHARKHA FRAME



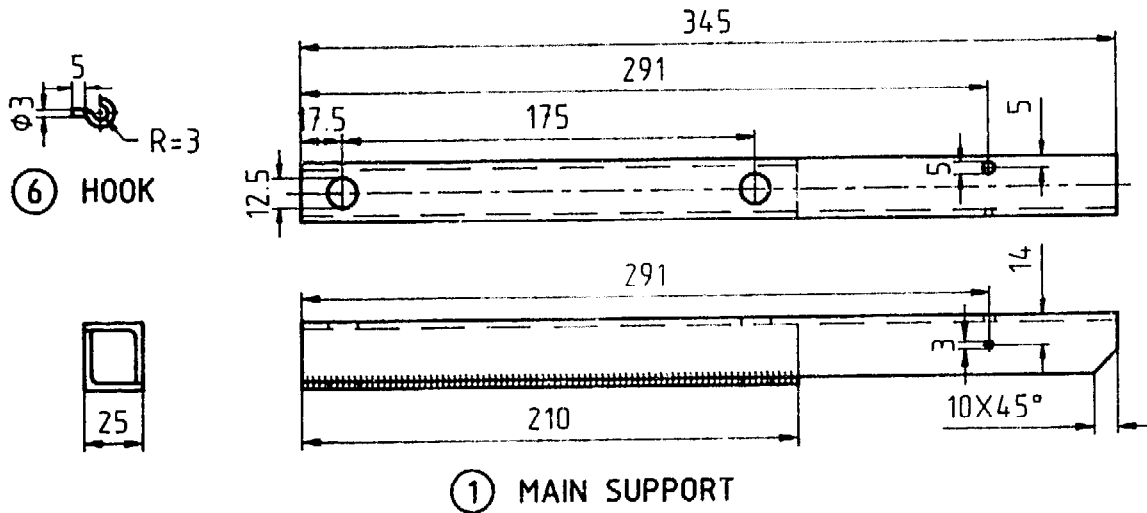
ASSEMBLED FINE YARN SPINNING MECHANISM BASE



② FRONT FLYER SUPPORT

③ GUIDE

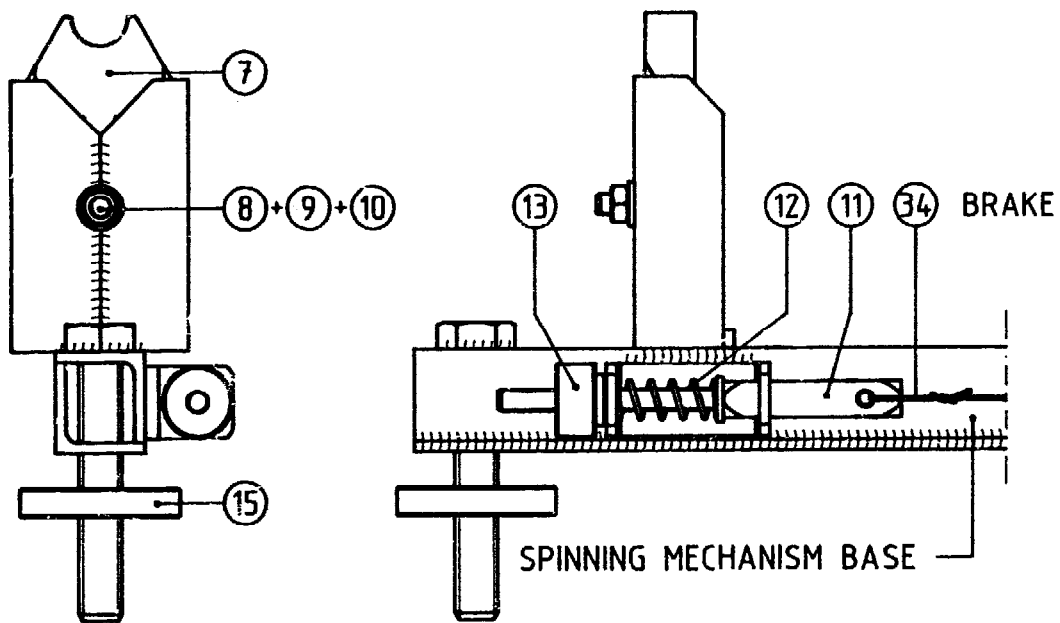
⑤ REAR SUPPORT



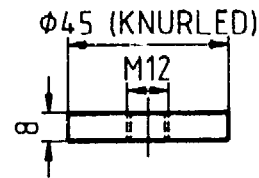
⑥ HOOK

① MAIN SUPPORT

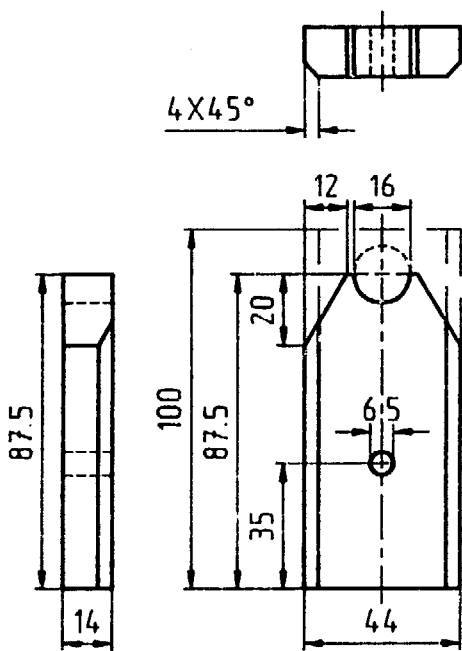
Drawing FY-02	Date: 01/05/91	SPINNING MECHANISM BASE
Scale: 1 : 3	Units: mm	FINE YARN SPINNING MECHANISM
TOOL Amsterdam Holland		MEDLERI CHARKHA



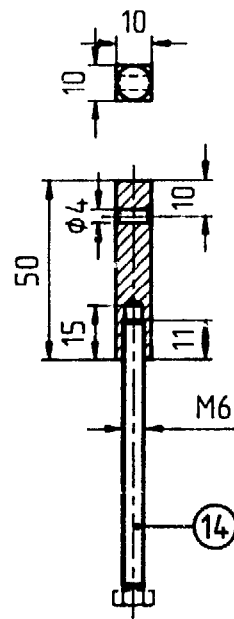
ASSEMBLED FRONT FLYER SUPPORT AND BRAKE MECHANISM



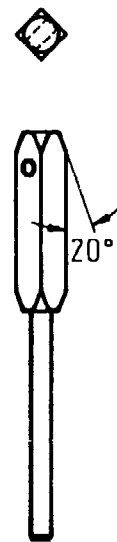
⑮ ADJUSTMENT NUT



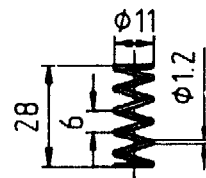
⑦ WOODEN BEARING



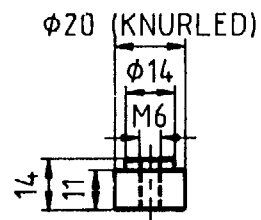
⑪ REGULATOR



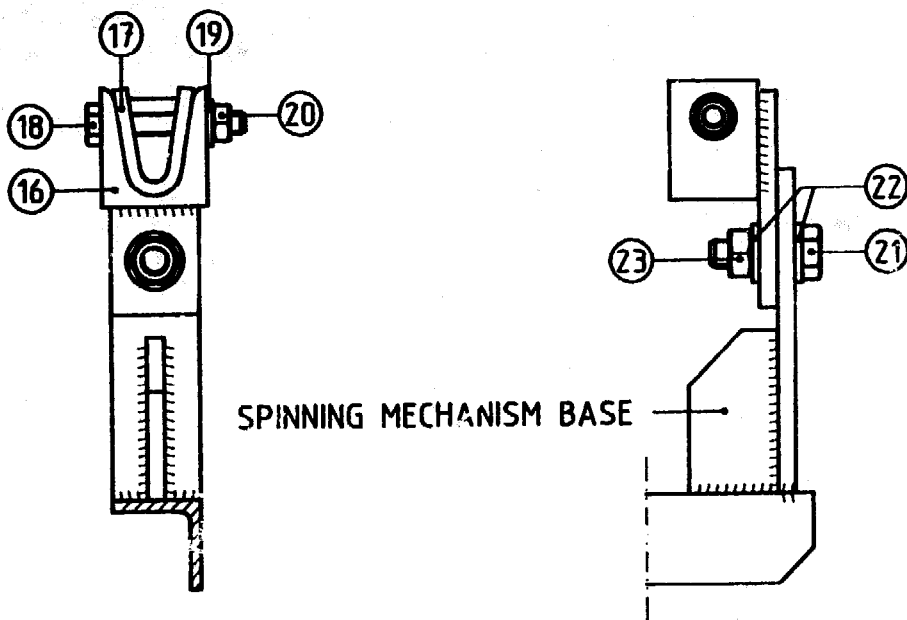
⑬ REGULATOR NUT



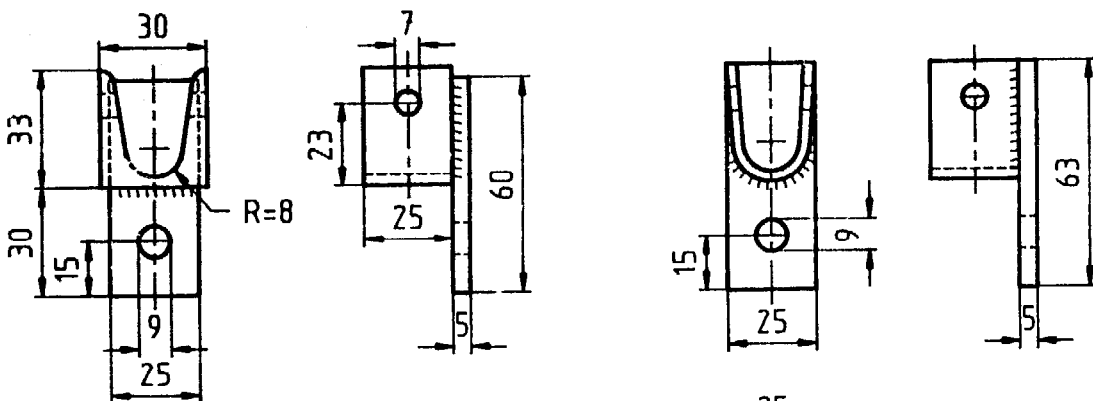
⑫ SPRING



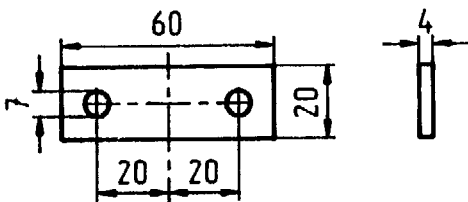
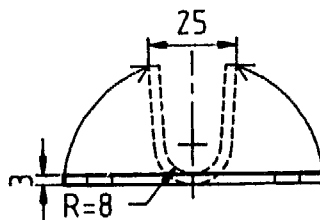
Drawing FY-03	Date: 01/05/91	Wooden bearing and Brake Mechanism
Scale: 1 : 2	Units: mm	FINE YARN SPINNING MECHANISM
TOOL Amsterdam Holland		MEDLERI CHARKHA



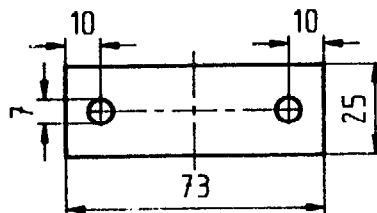
ASSEMBLED REAR FLYER SUPPORT



(16) REAR FLYER SUPPORT

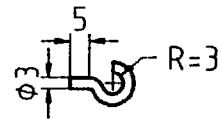
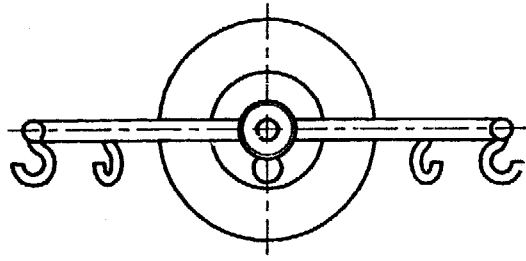


(17) PIECE OF LEATHER

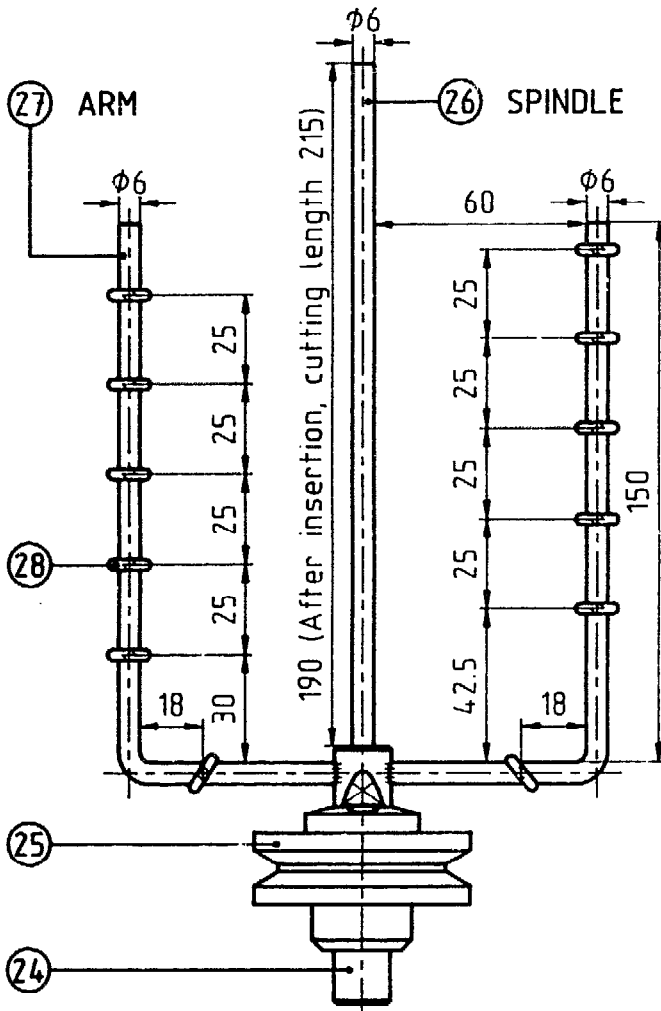


(16a) REAR FLYER SUPPORT  
(Alternative design)

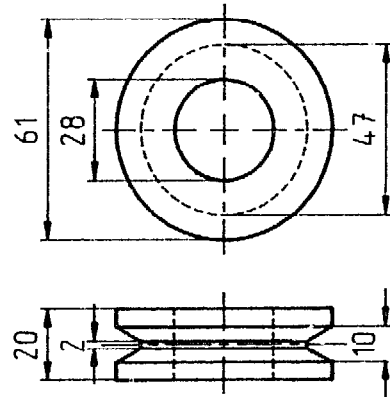
Drawing FY-04	Date: 01/05/91	Rear Flyer Support
Scale: 1 : 2	Units: mm	FINE YARN SPINNING MECHANISM
TOOL Amsterdam Holland		MEDLERI CHARKHA



(28) HOOK

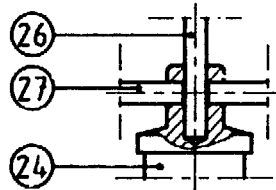
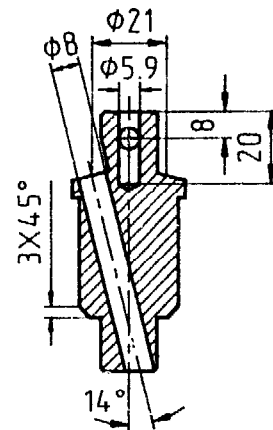


ASSEMBLED FLYER

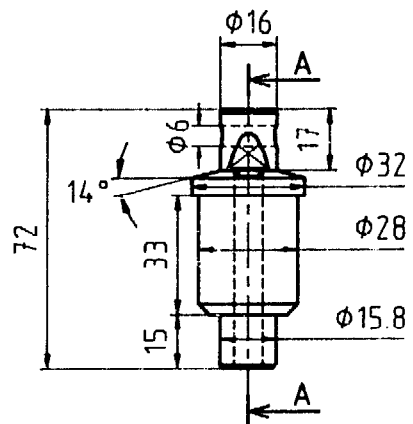


(25) PULLEY

SECTION A-A



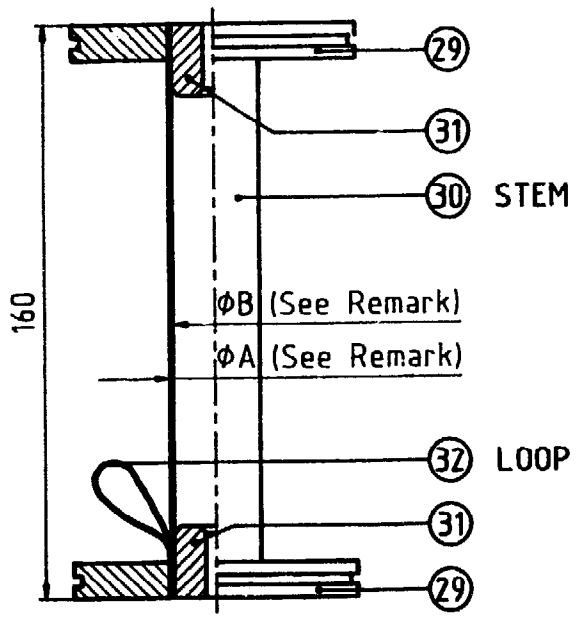
WELDING SPECIFICATION



(24) ORIFICE

Drawing FY-05	Date: 01/05/91	FLYER
Scale: 1 : 2	Units: mm	FINE YARN SPINNING MECHANISM
TOOL Amsterdam Holland		MEDLERI CHARKHA

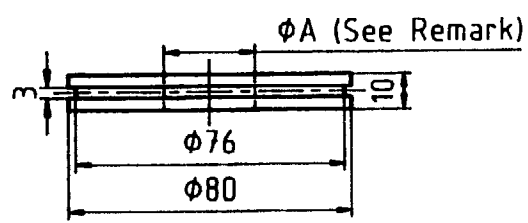
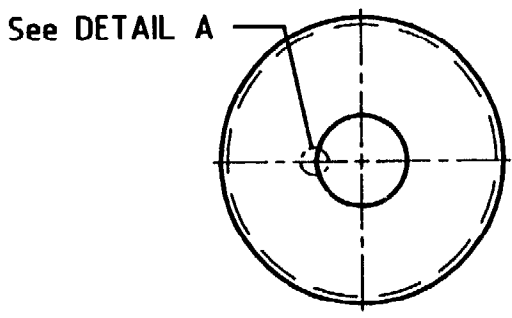




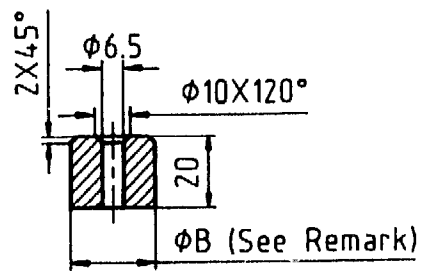
Remark regarding diameter A and B:  
 Measure diameter A and B of the pipe (used for the Stem) and make the Pulley and the Plug according to these dimensions.

ASSEMBLED BOBBIN

DETAIL A (Scale 5:1)  
 V-groove for LOOP

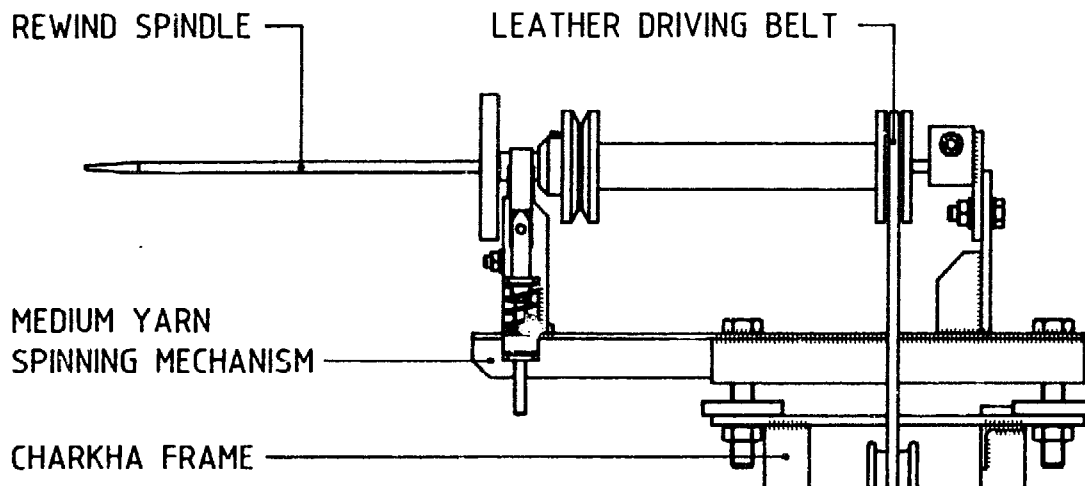


(29) PULLEY

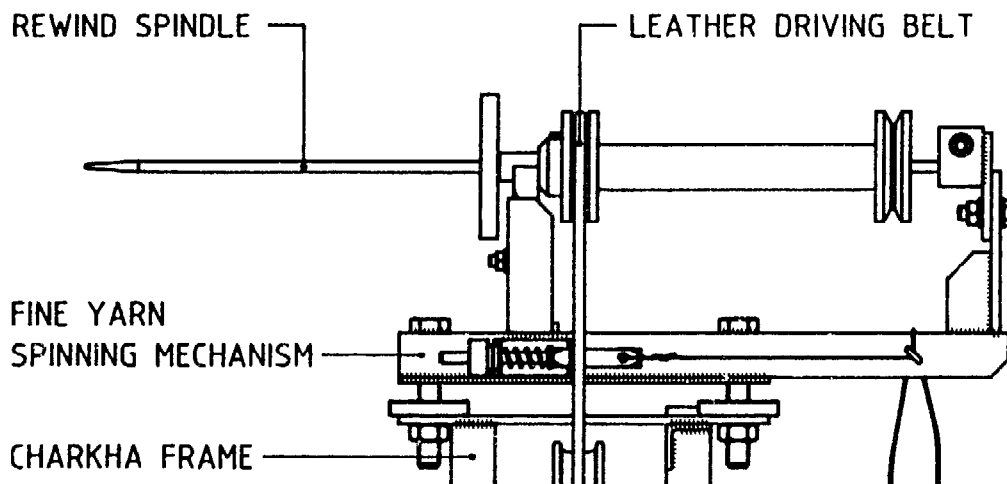


(31) PLUG

Drawing FY-06	Date: 01/05/91	BOBBIN
Scale: 1 : 2	Units: mm	FINE YARN SPINNING MECHANISM
TOOL Amsterdam Holland		MEDLERI CHARKHA



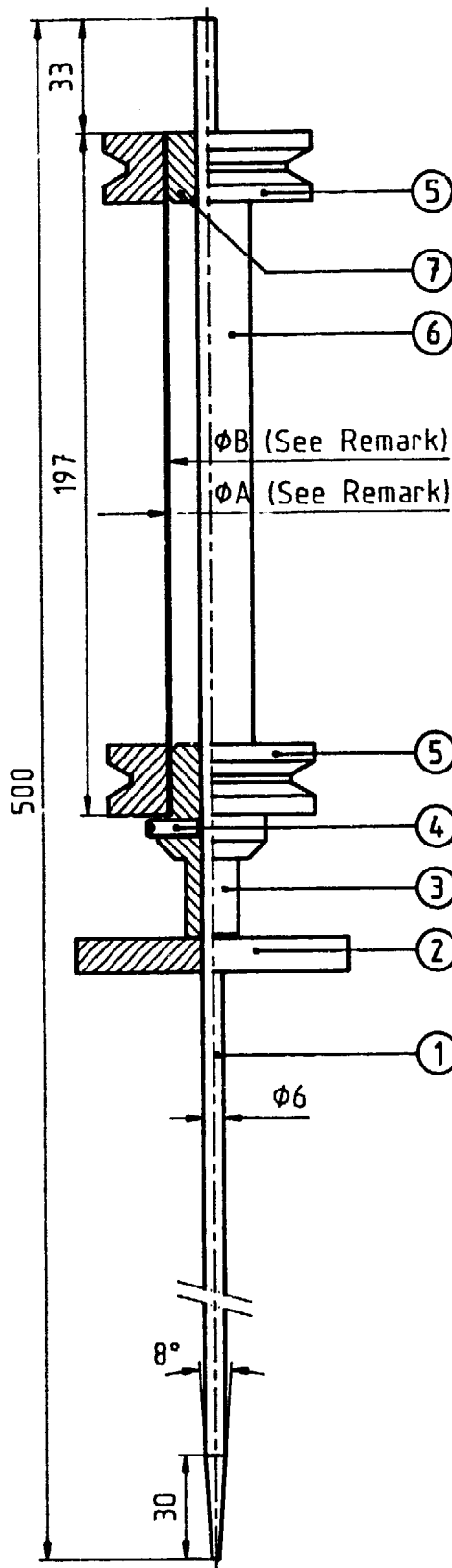
ASSEMBLED REWIND SPINDLE MOUNTED ON  
A MEDIUM YARN SPINNING MECHANISM



ASSEMBLED REWIND SPINDLE MOUNTED ON  
A FINE YARN SPINNING MECHANISM

Drawing RS-01	Date: 01/05/91	REWIND SPINDLE mounted on
Scale: 1 : 4	Units: mm	SPINNING MECHANISMS
TOOL Amsterdam Holland		MEDLERI CHARKHA

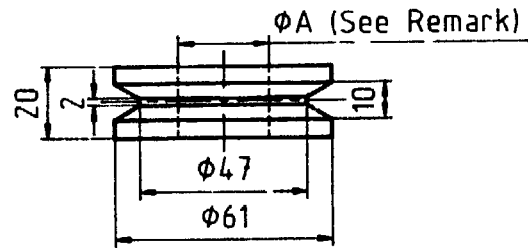
Remark regarding diameter A and B: Measure diameter A and B of the pipe (used for the Plastic body) and make the Iron body, Plug and Pulley according to these dimensions.



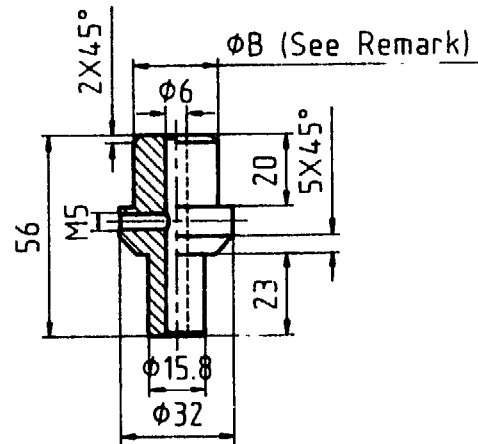
ASSEMBLED REWIND SPINDLE



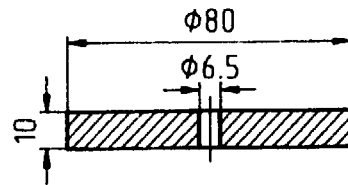
⑦ PLUG



⑤ PULLEY



③ IRON BODY



② WOODEN DISK

Drawing RS-02

Date: 01/05/91

REWIND SPINDLE

Scale: 1 : 2

Units: mm

TOOL Amsterdam Holland

MEDLERI CHARKHA

# 14 Components lists

## 14.1 Components list of a Medleri Charkha frame and transmission

- Assembled charkha frame Drawing CF-01
- Charkha frame Drawings CF-02 to CF-05
- Driving wheel Drawings CF-06 to CF-08
- Transmission Drawing CF-09
- Foot pedal Drawing CF-10
- Pulley of spinning mechanism
- Medium yarn Drawings MY-01 to MY-06
- Fine yarn Drawings FY-01 to FY-06
- Rewind spindle Drawings RS-01 to RS-02

<i>Component No</i>	<i>Name</i>	<i>detail</i>	<i>Material type</i>	<i>size (mm)</i>	<i>length (mm)</i>	<i>quantity</i>
42	Leather driving belt			∅ 6	2 metre	1
43	Hexagon bolt			M8 (5/16")	20	4
44	Washer			∅ 9 x ∅ 17 x 1 1/2		4
45	Hexagon nut			M8 (5/16")		4

### Charkha frame

Drawing CF-02

1	Ground frame	1.1	MS angle	25 x 25 x 3	466	2
		1.2	MS angle	25 x 25 x 3	360	1
		1.3	MS angle	25 x 25 x 3	208.5	1
		1.4	MS angle	25 x 25 x 3	160	1
			Welding rod			

Drawing CF-03

2	Front legs	2.1	MS angle	25 x 25 x 3	568	2
		2.2	MS angle	25 x 25 x 3	124	1

<b>Component No</b>	<b>Name</b>	<b>detail</b>	<b>Material type</b>	<b>size (mm)</b>	<b>length (mm)</b>	<b>quantity</b>
3	Rear leg	3.1	Welding rod			2
			MS angle	25 x 25 x 3	570	1
			MS angle	25 x 25 x 3	37.5	1
			Welding rod			1
<b>Drawing CF-04</b>						
4	Pedal hinge	4.1	MS UNP3	30 x 30 x 3	25	2
			MS flat	25 x 5	30	2
			Welding rod			1.5
4a	Pedal hinge (Alternative design)	4a.1	MS flat	25 x 3	61	2
			MS flat	25 x 3	73	2
			Welding rod			1.5
			Leather	20 x 3	60	2
5	Piece of leather					
6	Hexagon bolt			M6 (1/4")	35	2
7	Washer			ø 6 1/2 x ø 12 1/2 x 1 1/2		2
8	Hexagon nut			M6 (1/4")		2
9	Front support	9.1	MS angle	25 x 25 x 3	25	2
			9.2	MS round	ø 32	10
10	Rear support	10.1	Welding rod			2
			MS angle	25 x 25 x 3	25	1
			MS round	ø 32	10	1
			Welding rod			1
11	Cross-beam		MS flat	25 x 5	210	1
			Welding rod			1

### Driving wheel

Drawing CF-06

12	Bicycle wheel		18" (outer diameter rim 540mm)			1
13	Rubber rim tape		wide 30mm, made for 18" wheel			1
14	Slotted countersunk head screw		M6 (1/4")	12		8
15	Weight		MS round ø 32	27		8

<b>Component No</b>	<b>Name</b>	<b>detail</b>	<b>Material type</b>	<b>size (mm)</b>	<b>length (mm)</b>	<b>quantity</b>
16	Bearing support	16.1	MS round	ø 50	15	2
		16.2	MS flat	25 x 5	40	4
			Welding rod			
17	Piece of leather		Leather	15 x 2.5	110	2

Drawing CF-07

18	Bush		MS round	ø 32	10	2
19	Wheel shaft		MS round	ø 16	180	1

Drawing CF-08

20	Front ball-bearing		6201 LLU	ø 32 x ø 12 x 10		1
21	Washer			ø 14 x ø 24 x 2 <sup>1</sup> / <sub>2</sub>		1
22	Hexagon nut			M12 (1 <sup>1</sup> / <sub>2</sub> "		1
23	Rear ball-bearing		6200 LLU	ø 30 x ø 10 x 9		1
24	Washer			ø 9 x ø 17 x 1 <sup>1</sup> / <sub>2</sub>		1
25	Hexagon nut			M8 (5 <sup>1</sup> / <sub>16</sub> "		1

### Transmission

Drawing CF-09

26	Hexagon nut			M6 (1 <sup>1</sup> / <sub>4</sub> "		2
27	Washer			ø 6 <sup>1</sup> / <sub>2</sub> x ø 12 <sup>1</sup> / <sub>2</sub> x 1 <sup>1</sup> / <sub>2</sub>		1
28	Connecting rod		Sewing-machine spare part			1
29	Hexagon nut			M8 (5 <sup>1</sup> / <sub>16</sub> "		1
30	Washer			ø 9 x ø 25 x 2		1
31	Leather washer		Leather	ø 12 <sup>1</sup> / <sub>2</sub> x ø 25 x 3		2
32	Cross-head	32.1	MS round	ø 32	24	1
		32.2	MS round	ø 16	20	1
			Welding rod			
33	Nylon bush		Nylon	ø 1" x ø 1 <sup>1</sup> / <sub>2</sub> " x 1"		1
34	Hexagon bolt			M8 (5 <sup>1</sup> / <sub>16</sub> "	15	1
35	Crank head		MS round	ø 32	25	1
			Welding rod			
36	Crank arm	36.1	MS flat	25 x 5	72	1

<b>Component No</b>	<b>Name</b>	<b>detail</b>	<b>Material type</b>	<b>size (mm)</b>	<b>length (mm)</b>	<b>quantity</b>
		36.2	MS flat	25 x 5	38	1
			Welding rod			1
37	Crank pin		MS round	ø 16	59	1
			Welding rod			0.5
<b>Foot pedal</b>						Drawing CF-10
38	Pedal frame	38.1	MS angle	25 x 25 x 3	300	1
		38.2	MS flat	25 x 5	212	1
		38.3	MS round	ø 32	12	1
		38.4	MS round	ø 10	60	2
			Welding rod			2
39	Pedal cover		Plywood	thickness 10		1
40	Round head wood bolt			M6 (1/4")	25	4
41	Hexagon nut			M6 (1/4")		4

### Remarks

- The length given in the list does not include extra length needed for lathing or length for material which is wasted during cutting etc.
- For all welded parts: welding rod of ø 2.5mm is used.
- If no MS UNP 3 30 x 30 x 3 is available the alternative design (4a) can be chosen for component 4 Pedal hinge.

## 14.2 Shopping and cutting list for a frame and transmission

- Detail: number referring to components list.
- Final length: final length of a piece after shaping.
- Cutting length: final length plus extra length needed for shaping.
- Cutting waste: length wasted per piece in cutting.
- Quantity: number of pieces needed.
- Total: total requirement.

<i>Detail</i>	<i>Material type</i>	<i>Size</i>	<i>Final length (mm)</i>	<i>Cutting length (mm)</i>	<i>Cutting waste (mm)</i>	<i>Quantity</i>	<i>Total (mm)</i>
4.1	MS UNP 3	30 x 30 x 3	25	25	3	2	56
1.1	MS angle	25 x 25 x 3	466	466	3	2	938
1.2			360	360	3	1	363
1.3			208.5	208.5	3	1	211.5
1.4			160	160	3	1	163
2.1			568	568	3	2	1142
2.2			124	124	3	1	127
3.1			570	570	3	1	573
3.2			37.5	37.5	3	1	40.5
9.1			25	25	3	2	56
10.1			25	25	3	1	28
38.1			300	300	3	1	303
	MS angle	25 x 25 x 3	Total length:				3945
4.2	MS flat	25 x 5	30	30	3	2	66
11			210	210	3	1	213
16.2			40	40	3	4	172
36.1			72	72	3	1	75
36.2			38	38	3	1	41
38.2			212	212	3	1	215
	MS flat	25 x 5	Total length:				782
4a.1	MS flat	25 x 3	61	61	3	2	128
4a.2			73	73	3	2	152
	MS flat	25 x 3	Total length:				280



<i>Detail</i>	<i>Material type</i>	<i>Size</i>	<i>Final length (mm)</i>	<i>Cutting length (mm)</i>	<i>Cutting waste (mm)</i>	<i>Quantity</i>	<i>Total (mm)</i>
16.1	MS round	ø 50	15	17	3	2	40
9.2	MS round	ø 32	10	10	3	2	26
10.2			10	10	3	1	13
15			27	27	3	8	240
18			10	10	3	2	26
32.1			24	26	3	1	29
35			25	27	3	1	30
38.3			12	14	3	1	17
	MS round	ø 32	Total length:				381
19	MS round	ø 16	180	182	3	1	185
32.2			20	22	3	1	25
37			59	59	3	1	62
	MS round	ø 16	Total length:				272
38.4	MS round	ø 10	60	60	3	2	126
17	Leather	15 x 2.5	110	110	0	2	220
5	Leather	20 x 3	60	60	0	2	120

<i>Detail</i>	<i>Description</i>	<i>Quantity</i>
42	Leather driving belt ø 6 x 2 metres	1
28	Sewing-machine part	1
33	Nylon bush of water pump	1
12	Bicycle wheel 18" (approximately 540mm)	1
13	Rim tape 30 wide	1
20	Ball-bearing 6201-LLU	1
23	Ball-bearing 6200-LLU	1
39	Plywood 300 x 270 x 10	1
	Welding rods ø 2.5	18.5
14	Slotted countersunk head screw M6 x 12	8

<i>Detail</i>	<i>Description</i>		<i>Quantity</i>
40	Round head wood bolt	M6 x 25	4
6	Hexagon bolt	M6 x 35	2
34	Hexagon bolt	M8 x 15	1
43	Hexagon bolt	M8 x 20	4
	Hexagon nut	M6	8
	Hexagon nut	M8	6
22	Hexagon nut	M12	1
	Washer	∅ 6 <sup>1</sup> / <sub>2</sub> x ∅ 12 <sup>1</sup> / <sub>2</sub> x 1 <sup>1</sup> / <sub>2</sub>	3
	Washer	∅ 9 x ∅ 17 x 1 <sup>1</sup> / <sub>2</sub>	5
30	Washer	∅ 9 x ∅ 25 x 2	1
21	Washer	∅ 14 x ∅ 24 x 2 <sup>1</sup> / <sub>2</sub>	1
31	Leather washer	∅ 12 <sup>1</sup> / <sub>2</sub> x ∅ 25 x 3	2

### Remarks

- If MS UNP 3 is available, the pedal hinge can be made according to component 4. For this part no MS flat 25 x 3 needs to be bought.
- If MS UNP 3 is not available the pedal hinge has to be made according to component 4a. For this MS flat 25 x 3 has to be bought.

### 14.3 Components list of a medium yarn spinning mechanism

- Assembled spinning mechanism	Drawing MY-01
- Charkha frame	Drawing CF-01
- Leather driving belt	Drawing CF-01
- Spinning mechanism base	Drawing MY-02
- Front flyer support	Drawing MY-03
- Brake mechanism	Drawing MY-03
- Rear flyer support	Drawing MY-04
- Flyer	Drawing MY-05
- Bobbin	Drawing MY-06
25 Adjustment Nut	Drawing MY-04

<i>Component No</i>	<i>Name</i>	<i>detail</i>	<i>Material type</i>	<i>size (mm)</i>	<i>length (mm)</i>	<i>quantity</i>
34	Hexagon nut (2)			M12 (1/2")		2

#### Spinning mechanism base

Drawing MY-02

1	Main support	1.1	MS angle	25 x 25 x 3	345	1
		1.2	MS angle	25 x 25 x 3	210	1
			Welding rod			2
2	Front flyer support	2.1	MS angle	25 x 25 x 3	75	2
		2.2	MS flat	25 x 5	44	1
			Welding rod			1
3	Guide		MS flat	20 x 3	90	1
			Welding rod			1
4	Hexagon bolt			M12 (1/2")	75	2
			Welding rod			1
5	Rear support	5.1	MS flat	25 x 5	45	1
		5.2	MS flat	25 x 5	90	1
			Welding rod			1

Component No	Name	detail	Material type	size (mm)	length (mm)	quantity
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**Front flyer support**

**Brake mechanism**

Drawing MY-03

**Spinning mechanism base**

Drawing MY-02

6	Wooden bearing		Hard wood	44 x 14	87.5	1
7	Round head wood bolt			M6 (1/4")	25	1
8	Hexagon nut			M6 (1/4")		1
9	Washer			ø 6 1/2 x ø 12 1/2 x 1 1/2		1
10	Hexagon bolt			M5 (3/16")	10	2
11	Washer			ø 5 1/2 x ø 10 x 1		2
12	Leather brake		Leather	12 x 2	140	1
13	Regulator		MS square	10 x 10	50	1
14	Spring		Carburettor spring			1
15	Regulator nut		MS round	ø 20	14	1
16	Hexagon bolt			M6 (1/4")	75	1

**Rear flyer support**

Drawing MY-04

**Spinning mechanism base**

Drawing MY-02

17	Rear flyer support	17.1	MS UNP 3	30 x 30 x 3	25	1
		17.2	MS flat	25 x 5	60	1
			Welding rod			1
17a	Rear flyer support	17a.1	MS flat	25 x 3	73	1
	(Alternative design)	17a.2	MS flat	25 x 5	63	1
			Welding rod			1
18	Piece of leather		Leather	20 x 4	60	1
19	Hexagon bolt			M6 (1/4")	35	1
20	Washer			ø 6 1/2 x ø 12 1/2 x 1 1/2		1
21	Hexagon nut			M6 (1/4")		1
22	Hexagon bolt			M8 (5/16")	20	1
23	Washer			ø 9 x ø 17 x 1 1/2		2
24	Hexagon nut			M8 (5/16")		1
25	Adjustment nut		MS round	ø 45	8	2

<b>Component No</b>	<b>Name</b>	<b>detail</b>	<b>Material type</b>	<b>size (mm)</b>	<b>length (mm)</b>	<b>quantity</b>
<b>G Flyer</b>			<b>Drawing MY-05</b>			
26	Orifice		MS round	ø 25	45	1
27	Spindle		MS round	ø 6	240	1
28	Arm		MS round	ø 6	226	2
29	Hook		Hook			12
			Welding rod			1
<b>H Bobbin (3)</b>			<b>Drawing MY-06</b>			
30	Pulley		Hard wood	ø 61	20	6
31	Stem		PVC pipe	ø 25	180	3
32	Plug		Hard wood	ø 25	20	6
33	Loop		Art. silk yarn	ø 1	200	3
			Two-components glue			

### Remarks

- The length given in the list does not include extra length needed for lathing or length for material which is wasted during cutting, etc.
- For all welded parts: welding rod of ø 2.5mm is used.
- If no MS UNP 3 30 x 30 x 3 is available the alternative design (17a) can be chosen for component 17 rear flyer support.

### 14.4 Shopping and cutting list for a medium yarn spinning mechanism

- Detail: number referring to components list.
- Final length: final length of a piece after shaping.
- Cutting length: final length plus extra length needed for shaping.
- Cutting waste: length wasted per piece in cutting.
- Quantity: number of pieces needed.
- Total length: total requirement.

<i>Detail</i>	<i>Material Type</i>	<i>size</i>	<i>Final length (mm)</i>	<i>Cutting length (mm)</i>	<i>Cutting Waste (mm)</i>	<i>Number</i>	<i>Total length (mm)</i>
17.1	MS UNP 3	30 x 30 x 3	25	25	3	1	28
1.1	MS angle	25 x 25 x 3	345	345	3	1	348
1.2			210	210	3	1	213
2.1			75	75	3	2	156
	MS angle	25 x 25 x 3	Total length:				717
2.2	MS flat	25 x 5	44	44	3	1	47
5.1			45	45	3	1	48
5.2			90	90	3	1	93
17.2			60	60	3	1	63
17a.2			63	63	3	1	66
			MS flat	25 x 5	Total length (incl 17.2):		
			Total length (incl 17a.2):				254
17a.1	MS flat	25 x 3	73	73	3	1	76
3	MS flat	20 x 3	90	90	3	1	93
13	MS square	10 x 10	50	52	3	1	55
25	MS round	ø 45	8	10	3	2	26
26	MS round	ø 25	45	47	3	1	50
15	MS round	ø 20	14	16	3	1	19
27	MS round	ø 6	240	240	3	1	243
28			226	230	3	2	466
	MS round	ø 6	Total length:				709
18	Leather	20 x 4	60	60	0	1	60
12	Leather	12 x 2	140	140	0	1	140
6	Hard wood	44 x 14	87.5	110	3	1	113
30	Hard wood	ø 61	20	22	3	6	150
32	Hard wood	ø 25	20	22	3	6	150
31	PVC pipe	ø 25	180	182	3	3	555
33	Silk yarn	ø 1	200	200	0	3	600

<i>Detail</i>	<i>Description</i>	<i>Quantity</i>	
29	Hook	12	
14	Carburettor spring	1	
	Welding rods $\varnothing$ 2.5	9	
10	Hexagon bolt	M5 x 10	2
11	Washer	$\varnothing$ 5 $\frac{1}{2}$ x $\varnothing$ 10 x 1	2
7	Round head wood bolt	M6 x 25	1
16	Hexagon bolt	M6 x 75	1
19	Hexagon bolt	M6 x 35	1
22	Hexagon bolt	M8 x 20	1
4	Hexagon bolt	M12 x 75	2
	Hexagon nut	M6	2
24	Hexagon nut	M8	1
34	Hexagon nut	M12	2
	Washer	$\varnothing$ 6 $\frac{1}{2}$ x $\varnothing$ 12 $\frac{1}{2}$ x 1 $\frac{1}{2}$	2
23	Washer	$\varnothing$ 9 x $\varnothing$ 17 x 1 $\frac{1}{2}$	1

### Remarks

- If MS UNP 3 is available the pedal hinge can be made according to component 17. For this no MS flat 25 x 3 is needed. The total length of MS flat 25 x 5 to be bought is the total length including part 17.2
- If MS UNP 3 is not available, the pedal hinge has to be made according to component 17a. For this MS flat 25 x 3 is needed. The total length of MS flat 25 x 5 to be bought is the total length including part 17a.2

## 14.5 Components list of a fine yarn spinning mechanism

- Assembled spinning mechanism	Drawing FY-01
- Charkha frame	Drawing CF-01
- Leather driving belt	Drawing CF-01
- Spinning mechanism base	Drawing FY-02
- Front flyer support	Drawing FY-03
- Brake mechanism	Drawing FY-03
- Rear flyer support	Drawing FY-04
- Flyer	Drawing FY-05
- Bobbin	Drawing FY-06
15 Adjustment nut	Drawing FY-03

<i>Component No</i>	<i>Name</i>	<i>detail</i>	<i>Material type</i>	<i>size (mm)</i>	<i>length (mm)</i>	<i>quantity</i>
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33	Hexagon nut			M12 (1/2")		2
34	Brake		Art. silk yarn	ø 1	800	1

### Spinning mechanism base

Drawing FY-02

1	Main support	1.1	MS angle	25 x 25 x 3	345	1
		1.2	MS angle	25 x 25 x 3	210	1
			Welding rod			2
2	Front flyer support	2.1	MS angle	25 x 25 x 3	75	2
		2.2	MS flat	25 x 5	44	1
			Welding rod			1
3	Guide		MS flat	20 x 3	90	1
			Welding rod			1
4	Hexagon bolt			M12 (1/2")	75	1
			Welding rod			1
5	Rear support	5.1	MS flat	25 x 5	45	1
		5.2	MS flat	25 x 5	90	1
			Welding rod			1
6	Hook		Hook			1



<i>Component</i>			<i>Material</i>			
<i>No</i>	<i>Name</i>	<i>detail</i>	<i>type</i>	<i>size</i>	<i>length</i>	<i>quantity</i>
				<i>(mm)</i>	<i>(mm)</i>	
<b>Front flyer support</b>						
<b>Brake mechanism</b>						Drawing FY-03
<b>Spinning mechanism base</b>						Drawing FY-02
<b>34 Brake</b>						Drawing FY-01
7	Wooden bearing		Hard wood	44 x 14	87.5	1
8	Round head wood bolt			M6 (1/4")	25	1
9	Hexagon nut			M6 (1/4")		1
10	Washer			ø 6 1/2 x ø 12 1/2 x 1 1/2		2
11	Regulator		MS square	10 x 10	50	1
12	Spring		Carburettor spring			1
13	Regulator nut		MS round	ø 20	14	1
14	Hexagon bolt			M6 (1/4")	75	1
15	Adjustment nut		MS round	ø 45	8	2
<b>Rear flyer support</b>						Drawing FY-04
<b>Spinning mechanism base</b>						Drawing FY-02
16	Rear flyer support	16.1	MS UNP 3	30 x 30 x 3	25	1
		16.2	MS flat	25 x 5	60	1
			Welding rod			1
16a	Rear flyer support	16a.1	MS flat	25 x 3	73	1
	(Alternative design)	16a.2	MS flat	25 x 5	63	1
			Welding rod			1
17	Piece of leather		Leather	20 x 4	60	1
18	Hexagon bolt			M6 (1/4")	35	1
19	Washer			ø 6 1/2 x ø 12 1/2 x 1 1/2		1
20	Hexagon nut			M6 (1/4")		1
21	Hexagon bolt			M8 (5/16")	20	1
22	Washer			ø 9 x ø 17 x 1 1/2		2
23	Hexagon nut			M8 (5/16")		1
<b>Flyer</b>						Drawing FY-05
24	Orifice		MS round	ø 32	72	1
25	Pulley		Hard wood	ø 61	20	1

<b>Component No</b>	<b>Name</b>	<b>detail</b>	<b>Material type</b>	<b>size (mm)</b>	<b>length (mm)</b>	<b>quantity</b>
26	Spindle		MS round	ø 6	215	1
27	Arm		MS round	ø 6	216	2
28	Hook		Hook			12
			Welding rod			1
			Two-components glue			
<b>Bobbin (3)</b>			<b>Drawing FY-06</b>			
29	Pulley		Hard wood	ø 81	10	6
30	Stem		PVC pipe	ø 25	160	3
31	Plug		Hard wood	ø 25	20	6
32	Loop		Art. silk yarn	ø 1	200	3
			Two-components glue			

### Remarks

- The length given in the list does not include extra length needed for lathing or length for material which is wasted during cutting, etc.
- For all welded parts: welding rod of ø 2.5mm is used.
- If no MS UNP 3 30 x 30 x 3 is available the alternative design (16a) can be chosen for component 16 Rear flyer support.

## 14.6 Shopping and cutting list for a fine yarn spinning mechanism

- Detail: number referring to components list.
- Final length: final length of a piece after shaping.
- Cutting length: final length plus extra length needed for shaping.
- Cutting waste: length wasted per piece in cutting.
- Quantity: number of pieces needed.
- Total: total requirement.

<i>Detail</i>	<i>Material type</i>	<i>Size</i>	<i>Final length (mm)</i>	<i>Cutting length (mm)</i>	<i>Cutting waste (mm)</i>	<i>Quantity</i>	<i>Total (mm)</i>
16.1	MS UNP 3	30 x 30 x 3	25	25	3	1	28
1.1	MS angle	25 x 25 x 3	345	345	3	1	348
1.2			210	210	3	1	213
2.1			75	75	3	2	156
	MS angle	25 x 25 x 3	Total length:				717
2.2	MS flat	25 x 5	44	44	3	1	47
5.1			45	45	3	1	48
5.2			90	90	3	1	93
16.2			60	60	3	1	63
(16a.2 see remark)			63	63	3	1	66
	MS flat	25 x 5	Total length (incl 16.2):				251
			Total length (incl 16a.2):				254
16a.1	MS flat	25 x 3	73	73	3	1	76
3	MS flat	20 x 3	90	90	3	1	93
11	MS square	10 x 10	50	52	3	1	55
15	MS round	ø 45	8	10	3	2	26
24	MS round	ø 32	72	74	3	1	77
13	MS round	ø 20	14	16	3	1	19
26	MS round	ø 6	215	215	3	1	218
27			216	220	3	2	446
	MS round	ø 6	Total length:				664
17	Leather	20 x 4	60	60	0	1	60
7	Hard wood	44 x 14	87.5	110	3	1	113
29	Hard wood	ø 81	10	12	3	6	90
25	Hard wood	ø 61	20	22	3	1	25
31	Hard wood	ø 25	20	22	3	6	150
30	PVC pipe	ø 25	160	162	3	3	495

<i>Detail</i>	<i>Material type</i>	<i>Size</i>	<i>Final length (mm)</i>	<i>Cutting length (mm)</i>	<i>Cutting waste (mm)</i>	<i>Quantity</i>	<i>Total (mm)</i>
32	Art. silk yarn	ø 1	200	200	0	3	600
34			800	800	0	1	800
Art. silk yarn ø 1 Total length:							1400

<i>Detail</i>	<i>Description</i>	<i>Quantity</i>
	Hook	13
12	Carburettor spring	1
	Welding rods ø 2.5	9
8	Round head wood bolt M6 x 25	1
14	Hexagon bolt M6 x 75	1
18	Hexagon bolt M6 x 35	1
21	Hexagon bolt M8 x 20	1
4	Hexagon bolt M12 x 75	2
	Hexagon nut M6	2
23	Hexagon nut M8	1
33	Hexagon nut M12	2
	Washer ø6 1/2 x ø12 1/2 x 1 1/2	3
22	Washer ø9 x ø17 x 1 1/2	1

### Remark

- If MS UNP 3 is available the Pedal hinge can be made according to component 16. For this no MS flat 25 x 3 needed. The total length of MS flat 25 x 5 to be bought is the total length including part 16.2
- If MS UNP 3 is not available the pedal hinge has to be made according to component 16a. For this MS flat 25 x 3 is needed. The total length of MS flat 25 x 5 to be bought is the total length including part 16a.2

## 14.7 Components list of a rewind spindle (accessory)

Assembled rewind spindle	Drawing RS-01
- Rewind Spindle	Drawing RS-02
- Charkha frame	Drawing CF-01
- Leather driving belt	Drawing CF-01
- Medium yarn spinning mechanism	Drawing MY-01
- Fine yarn spinning mechanism	Drawing FY-01

<i>Component No</i>	<i>Name</i>	<i>Material detail</i>	<i>Material type</i>	<i>size (mm)</i>	<i>length (mm)</i>	<i>quantity</i>
<b>Rewind spindle</b>						Drawing RS-02
1	Spindle		MS round	ø 6	500	1
2	Wooden disk		Hard wood	ø 81	10	1
3	Iron body		MS round	ø 32	56	1
4	Slotted clamping set screw		M5 (3/16")		15	1
5	Pulley		Hard wood	ø 61	20	2
6	Plastic body		PVC pipe	ø 25	197	1
7	Plug		Hard wood	ø 25	20	1
			Two-components glue			

### Remarks

- The length given in the list does not include extra length needed for lathing or length for material which is wasted during cutting etc.

## 14.8 Shopping and cutting list for a rewind spindle

- Detail: number referring to components list.
- Final length: final length of a piece after shaping.
- Cutting length: final length plus extra length needed for shaping.
- Cutting waste: length wasted per piece in cutting.
- Quantity: number of pieces needed.
- Total: total requirement.

<i>Detail</i>	<i>Material type</i>	<i>Size</i>	<i>Final length (mm)</i>	<i>Cutting length (mm)</i>	<i>Cutting waste (mm)</i>	<i>Quantity</i>	<i>Total (mm)</i>
3	MS round	ø 32	56	58	3	1	61
1	MS round	ø 6	500	500	3	1	503
2	Hard wood	ø 81	10	12	3	1	15
5	Hard wood	ø 61	20	22	3	2	50
7	Hard wood	ø 25	20	22	3	1	25
6	PVC pipe	ø 25	197	199	3	1	202

<i>Detail</i>	<i>Description</i>	<i>Quantity</i>
4	Slotted clamping set screw M5 x 15	1