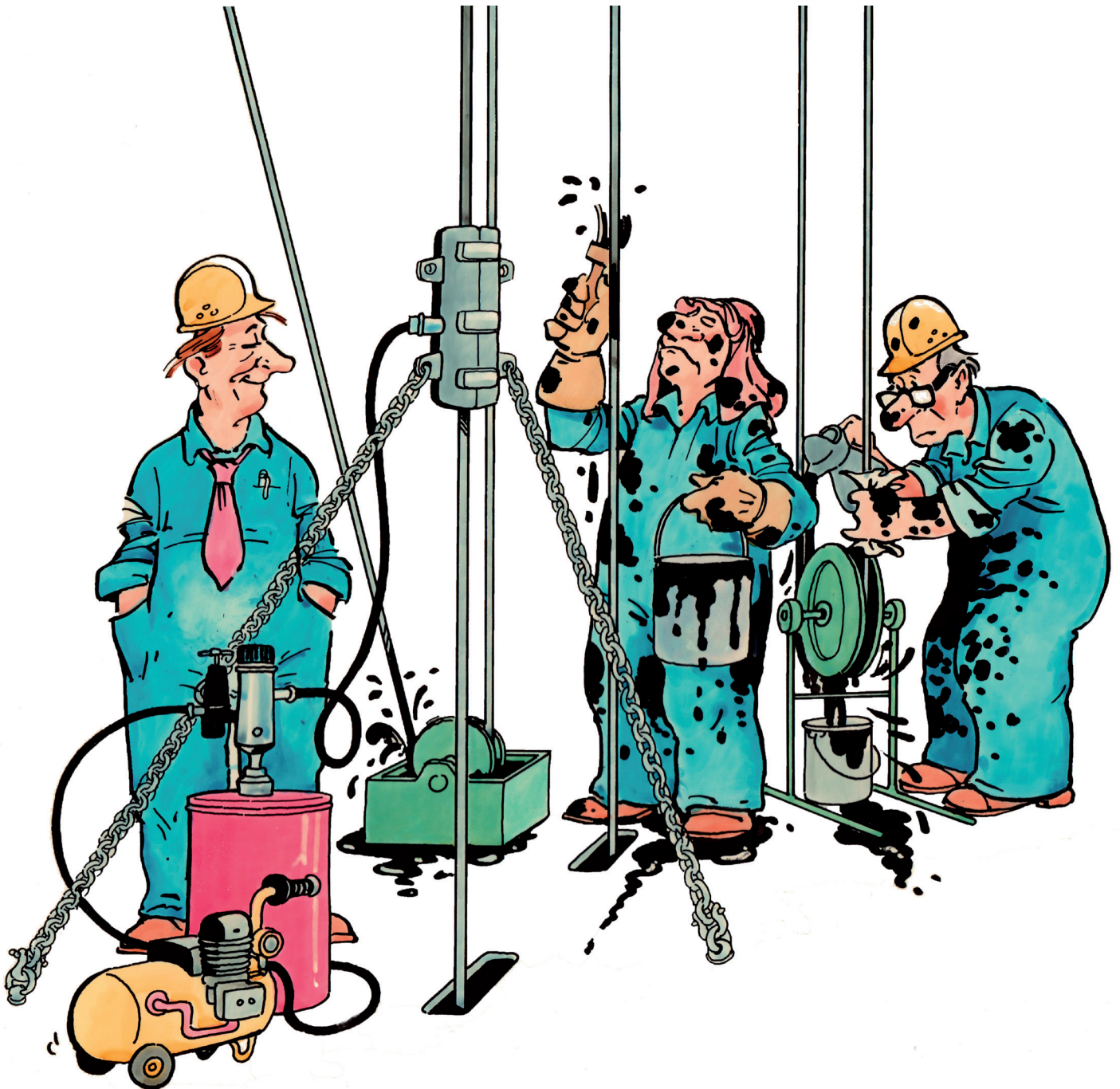


WIRE ROPE

TECHNOLOGY AACHEN



**Handling, Installation and
Maintenance of Steel Wire Ropes**

Handling, Installation and Maintenance of Steel Wire Ropes

by Dipl.-Ing. Roland Verreet

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1. The handling of steel wire ropes

1.1. How steel wire ropes should be unloaded

When handling a steel wire rope, the first trouble often occurs immediately upon receiving it: the fork of the fork lift truck is either placed under the reel or inside the coil (Fig. 1).

In both cases it might damage the surface of the rope. The damage may not be discovered until much later and it could happen that the manufacturer of the wire rope is held responsible. If possible, the rope, when received on coils or reels, should not have any contact with a metal hook or the fork of a forklift truck. Instead, it should be lifted by means of a wide textile webbing sling (Fig. 2).

It is advisable to lift a reel by means of a shaft which is put through its axis bore (Fig. 3 and Fig. 4). If the fork of the forklift truck is longer than the width of the reel, the reel can also be lifted at the flanges.

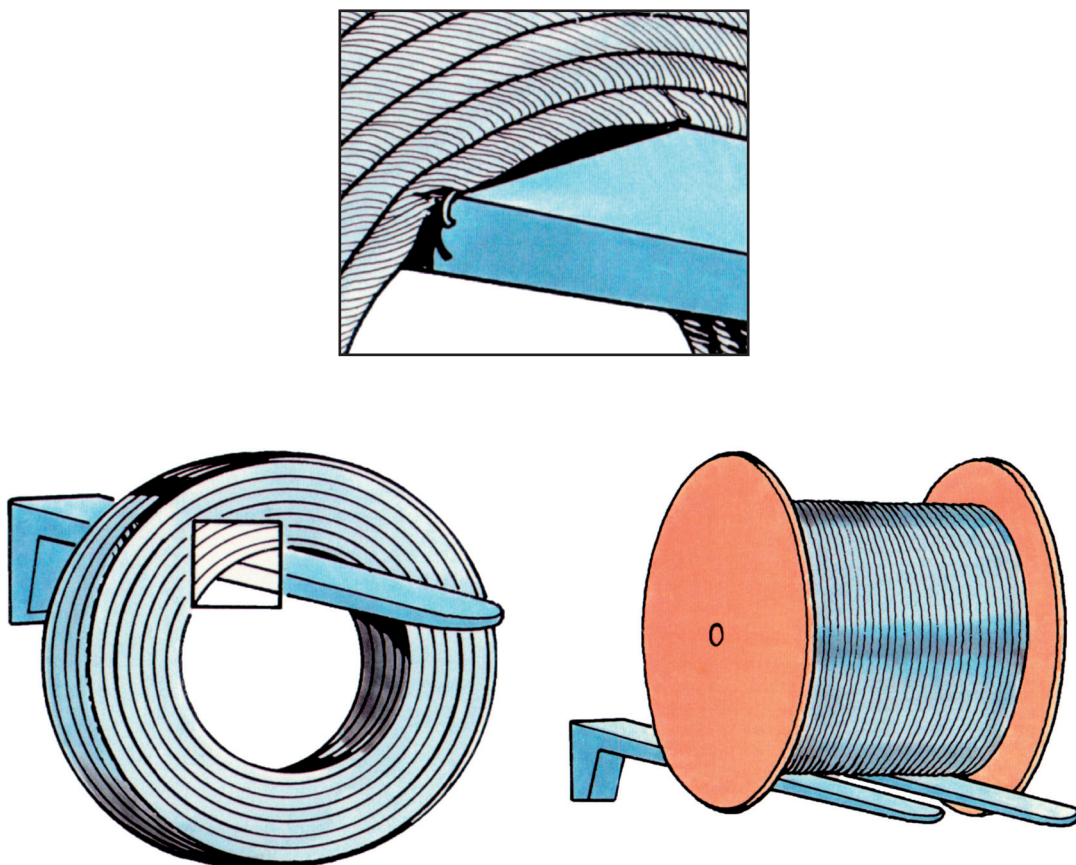


Fig. 1

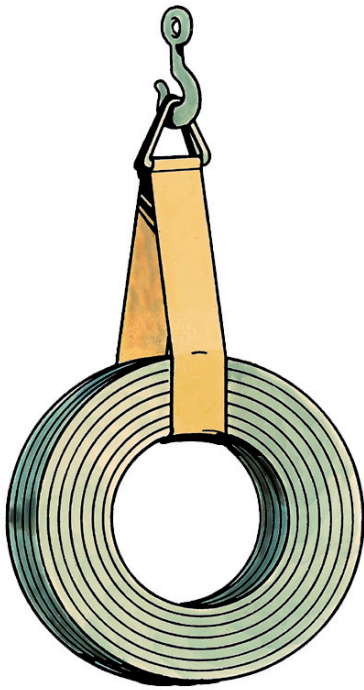


Fig. 2

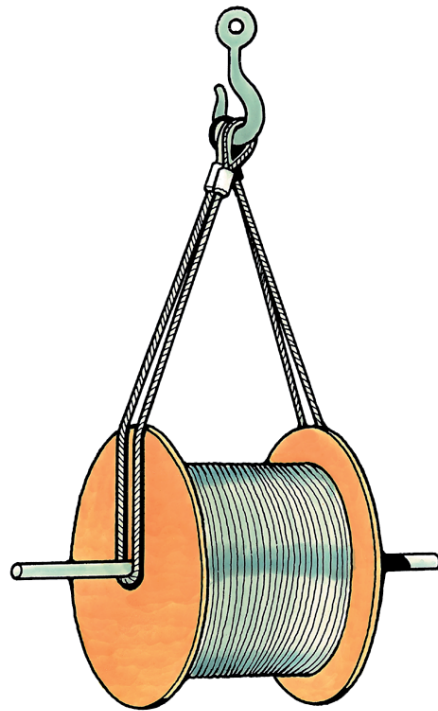


Fig. 3

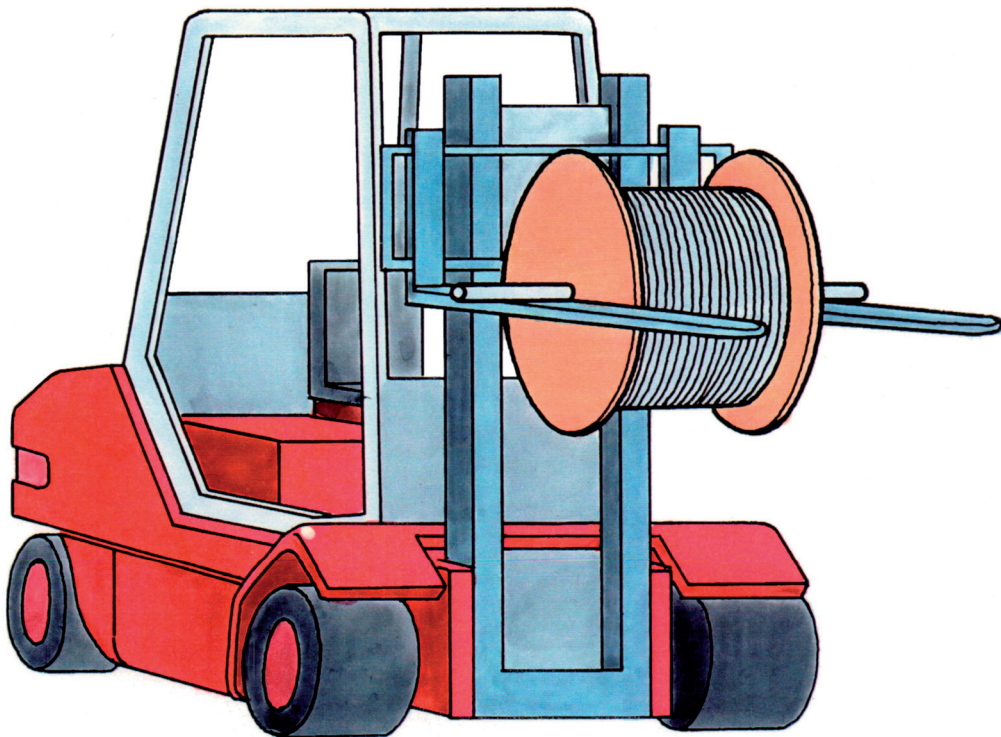


Fig. 4

1.2. How steel wire ropes should be stored

Steel wire ropes should be stored in a clean, cool, dry place indoors. The ropes must not be allowed to rest on the floor. They can be placed on pallets (Fig. 5).

If outdoor storage cannot be avoided the ropes must be covered in a way that moisture cannot create corrosion problems (Fig. 6). Although plastic foil protects the ropes from rain, condensation from beneath might not be able to escape and could damage the ropes permanently. To avoid condensation problems, it is advisable to use breathable water-proof fabric covers readily available from tarpaulin manufacturers.

When storing a number of spare ropes, the following rule should be applied: first

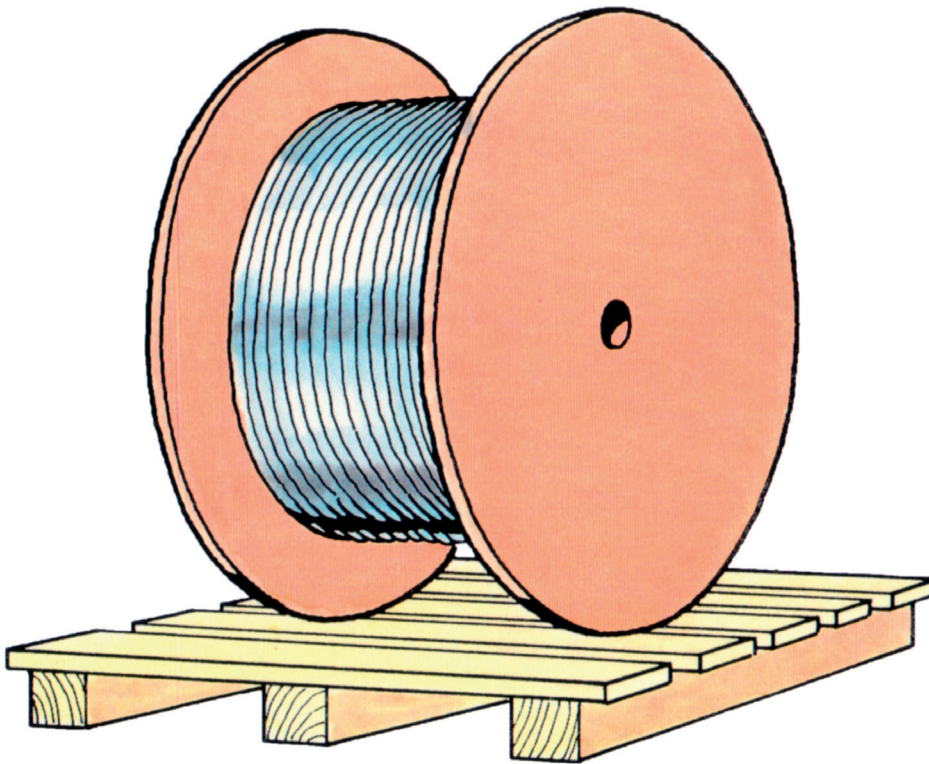


Fig. 5

in - first out.

This means, the ropes should be used in the order of delivery. In this way it can be avoided that certain ropes are only put into service after being stored for many years.

It is self-evident that the different ropes in stock must be clearly marked to avoid the possibility of confusion (e.g. if similar ropes of different tensile strength are stored.) In addition proper records have to be kept which make it possible to trace the “history” of any rope back to the manufacturer on the basis of storing number, specification, date of order and date of delivery.

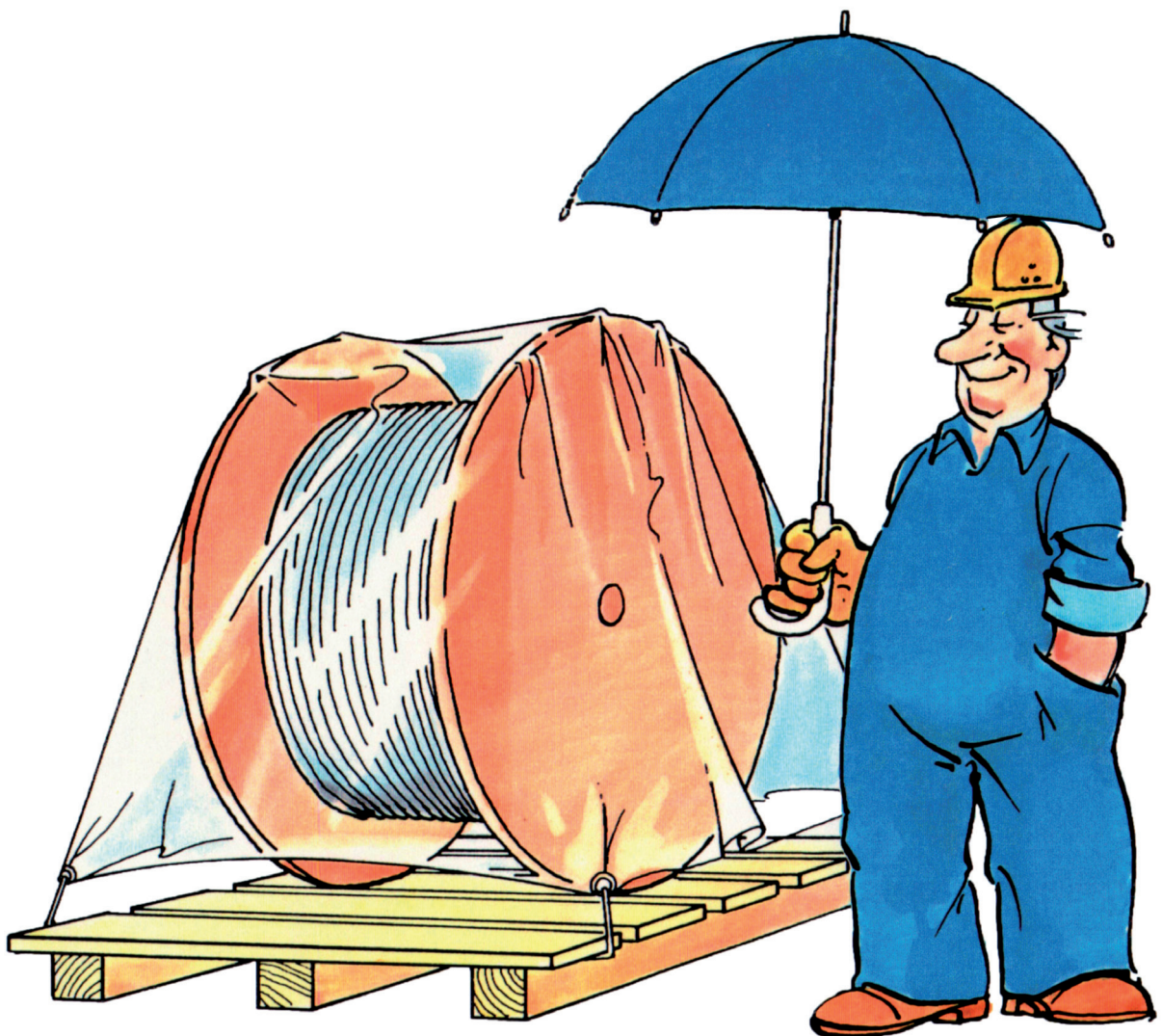


Fig. 6

2. The installation of steel wire ropes

When installing steel wire ropes, extra care must be taken that the ropes are unwound from the ring or reel without torsions and without any outer damage. The same applies to reeving the ropes into the system.

2.1. Unwinding a steel wire rope from the coil

If a rope is delivered on a coil, it is either unwound on a turntable (Fig. 7) or the coil is rolled along the ground like a hoop (Fig. 8). In the latter case ensure that the surface is clean; sand or grit that sticks to the lubricant might damage the wires when the rope travels over sheaves.

2.2. Unwinding the steel wire rope from the reel

An unreeling stand (turntable) should be used to unwind a wire rope from its reel (Fig. 9). Another accepted unreeling method is to mount the reel on a shaft supported by two jacks (Fig. 10).

Rolling the wire rope along the floor (Fig. 11), as it is sometimes recommended in the relevant literature, does not work very well in practice because the reel always unwinds less wire than the distance the reel travels, so that with this method the rope has to be dragged along by the worker.

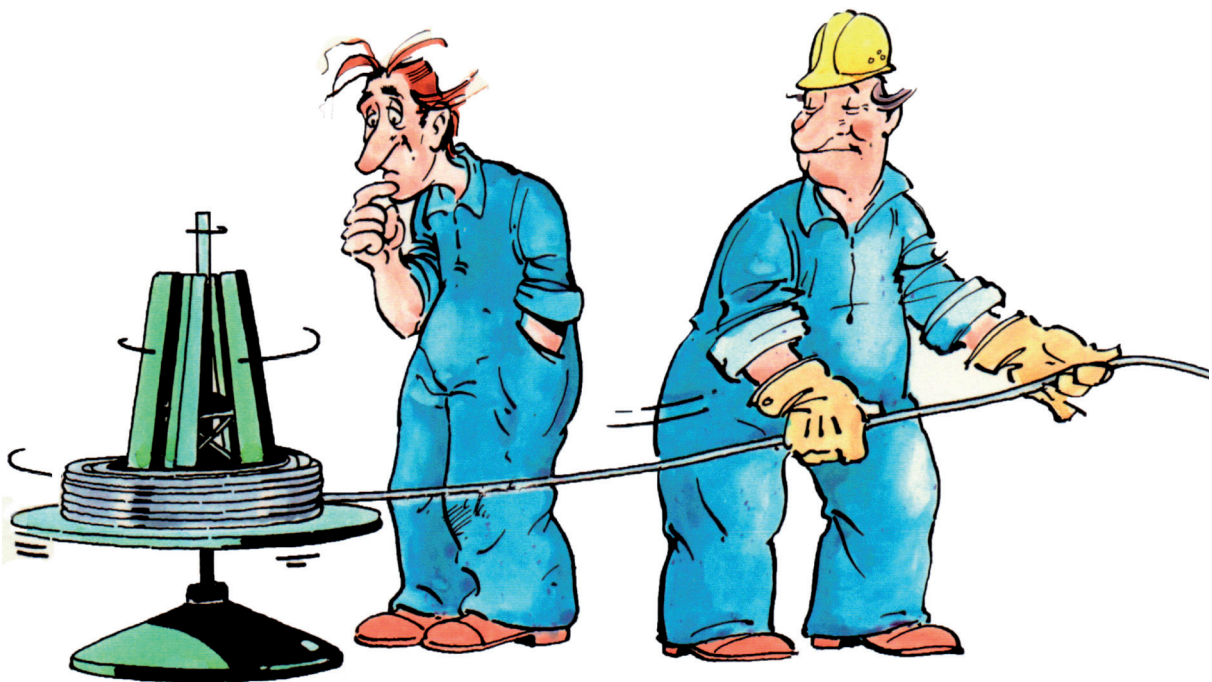


Fig. 7

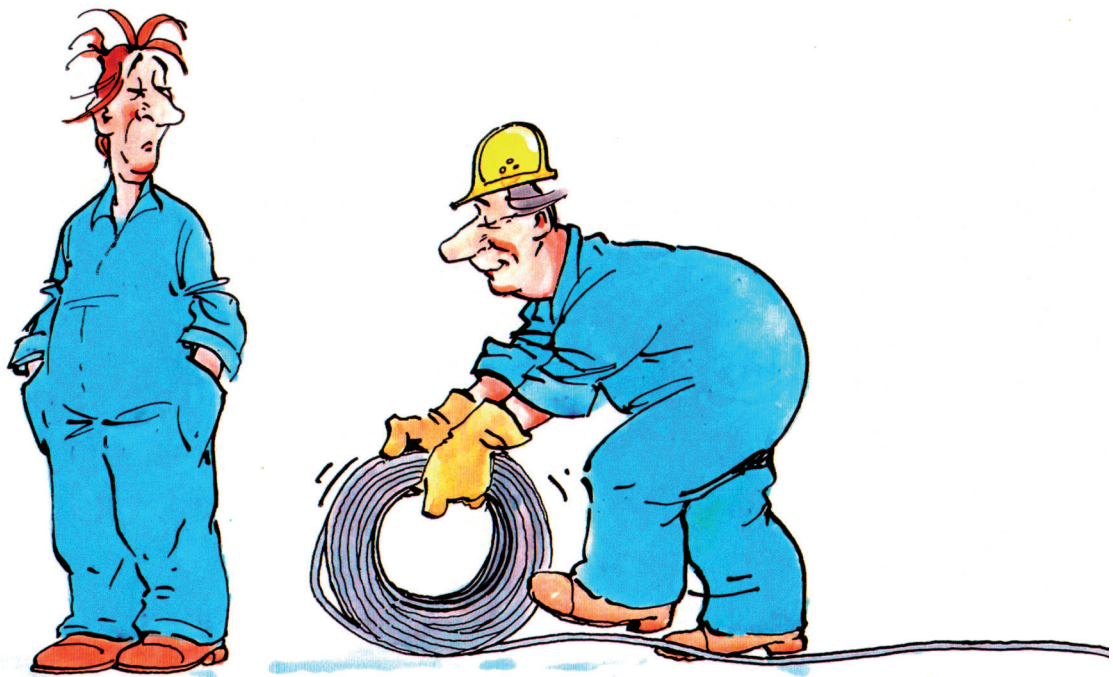


Fig. 8

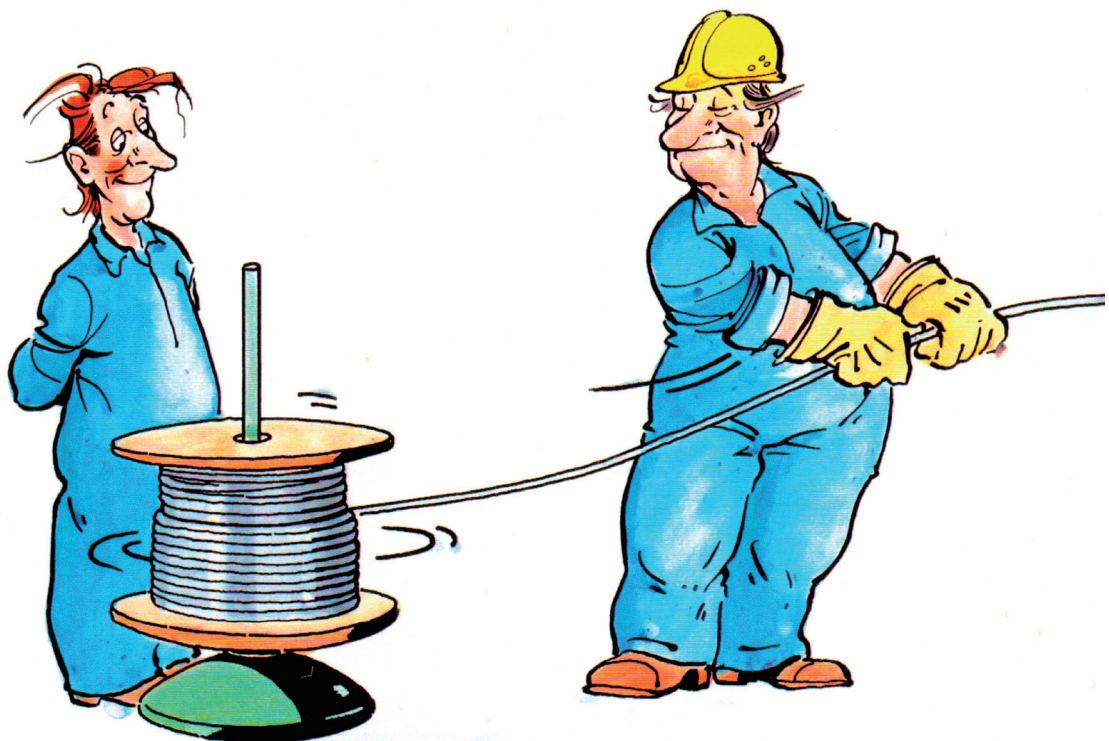


Fig. 9

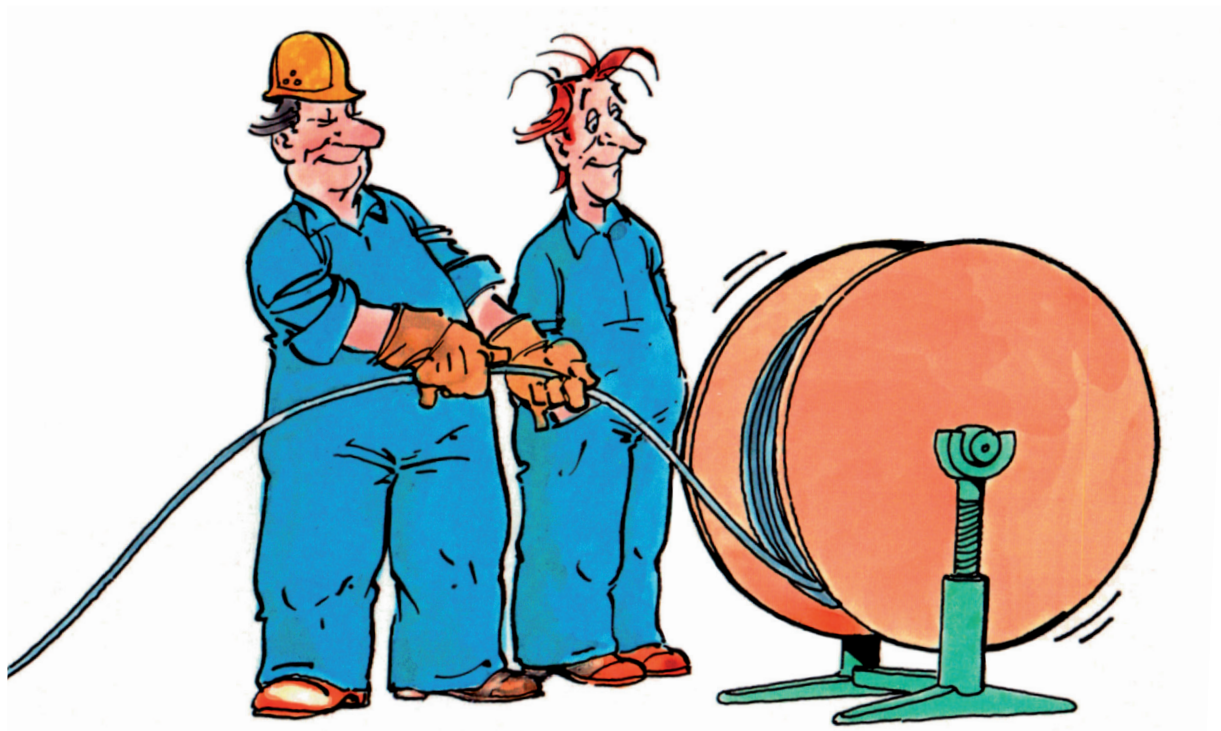


Fig. 10



Fig. 11

Under no circumstances must the rope be pulled off a coil while it is lying on the ground or looped over the head of the reel (Fig. 12 and Fig. 13), because this procedure will inevitably induce one torsion per wrap into the rope.

Every torsion will change the lay lengths of the strands and of the wire rope; at the same time the proportions of lengths of the rope elements and finally the distribution of load within the rope are changed.

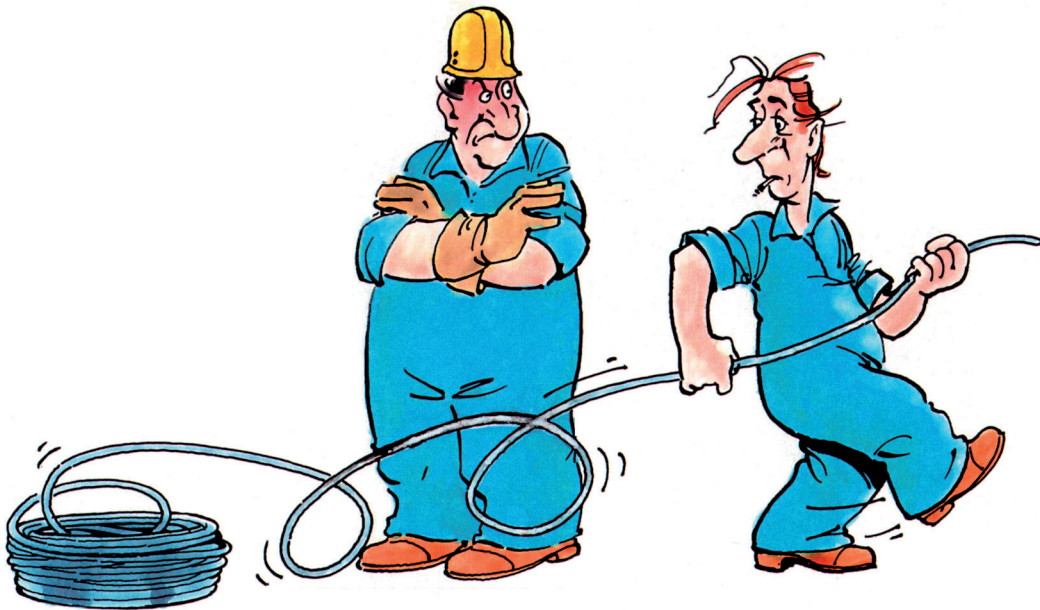


Fig. 12

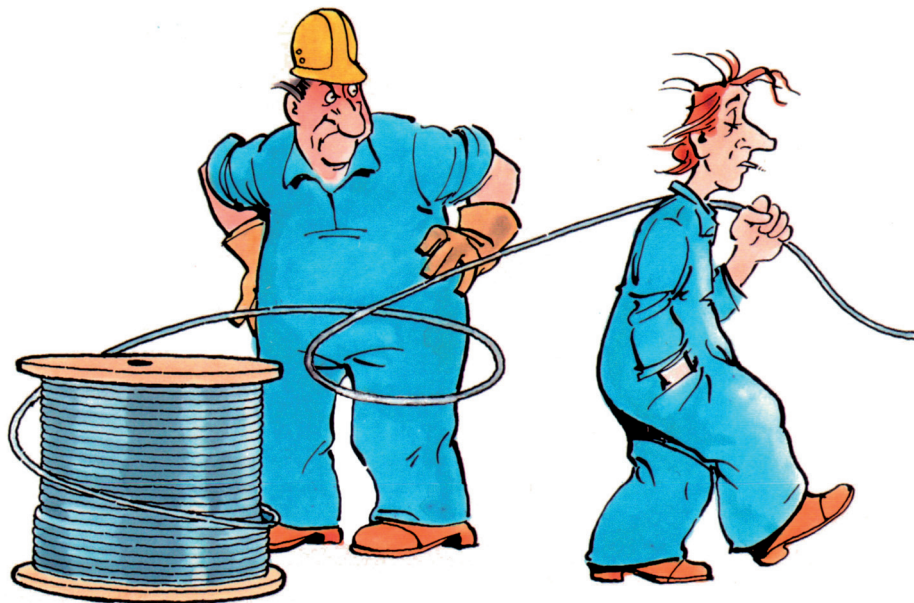


Fig. 13

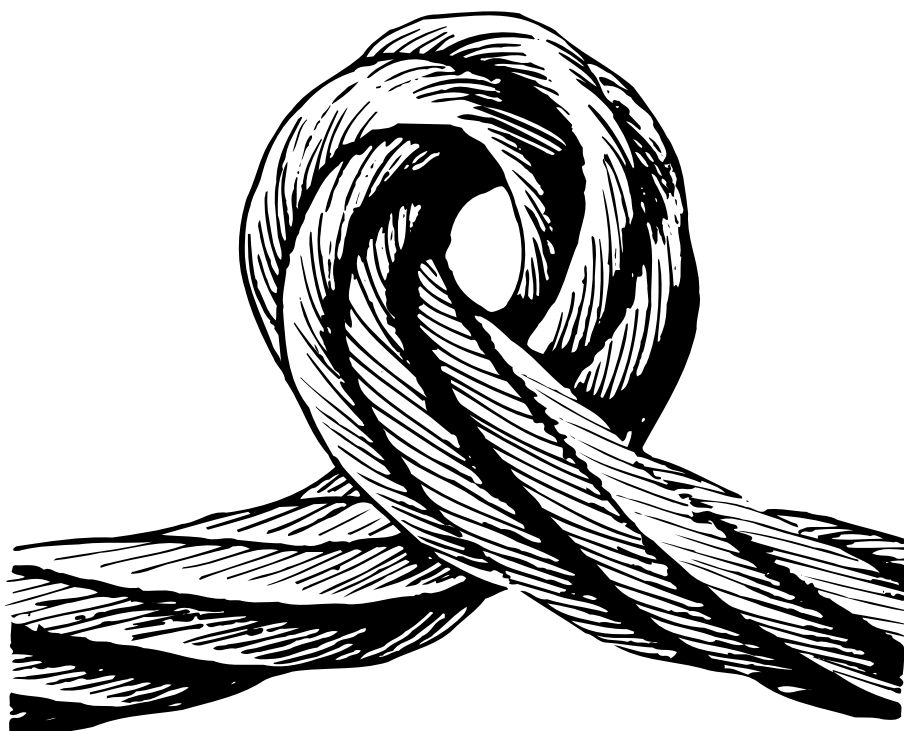


Fig. 14

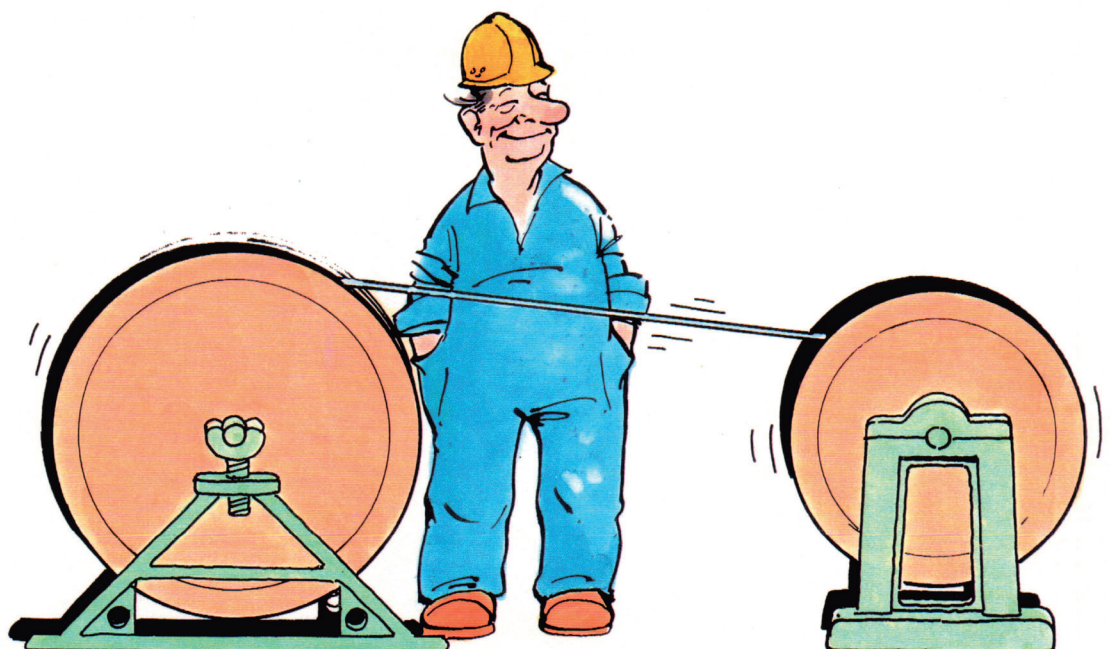


Fig. 15

A rope that is unwound at the sides of the coil or reel will try to resist the enforced torsions and form loops. When pulled taut these loops will result in irreparable kinks (Fig. 14). Steel wire ropes with kinks are not safe to operate and must be discarded.

2.3. The installation procedure

The most advantageous way of installing a steel wire rope varies from system to system. In any case a procedure should be chosen that (under justifiable expenditure) guarantees the least risk of torsions and avoids damage to the rope by contact with parts of the construction.

With some machines it may be advisable to discard the old rope first and to install the new one afterwards. With other machines, particularly with bigger ones, it might be better to pull in the new rope attached to the old one. Another possibility is to use a thinner rope by which the wire rope proper is pulled into the system. This method is often used with new equipment.

In every single case careful consideration is necessary as to whether the wire rope should be pulled through the whole reeving system or whether it should first be wound from the coil or reel onto the drum and afterwards be reeved into the system.

If one end of the rope has a fitting attached, there is no other possibility than pulling the loose rope end through the whole reeving system.

2.4. Winding the steel wire rope from the reel onto the drum

During the manufacturing process every steel wire rope receives its preferred bending direction when being drawn from the wire rope closer by means of a capstan. When delivered to the customer the rope is bent in that direction. Make certain that it bends in the same direction when it is wound from the reel onto the drum (Fig. 15). If the rope is wound at the bottom of the drum, it should leave the reel at the bottom and vice versa: i.e., always reel from top to top or from bottom to bottom.

If this procedure is not strictly followed, the rope will either try to twist between reel and drum or it will later try to regain its preferred position when in practical service. In both cases structural changes of the rope may occur (Fig. 16).

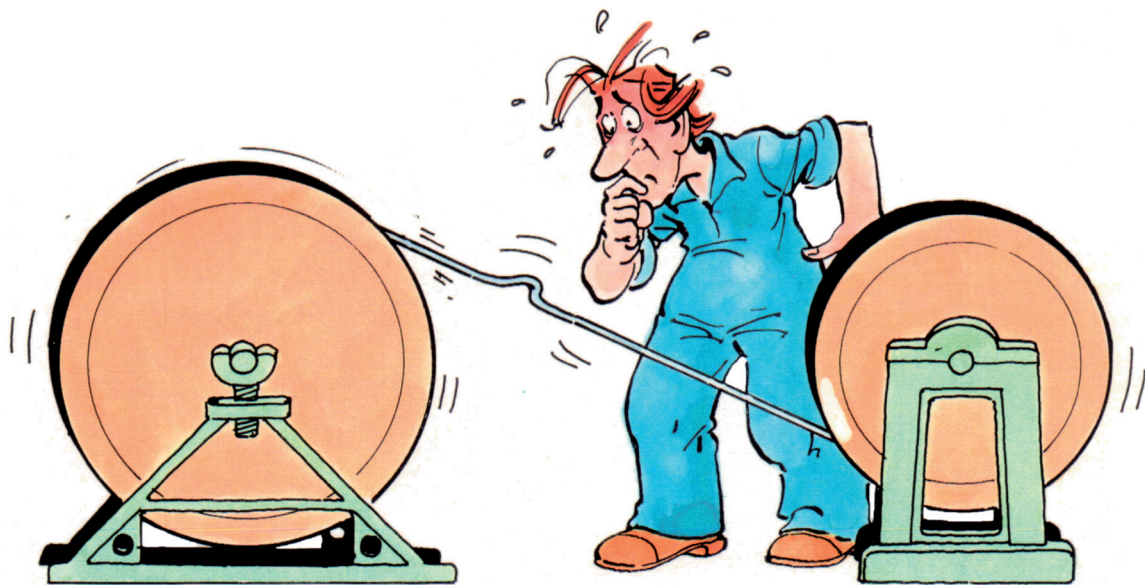


Fig. 16

2.5. Installing the new rope with the help of the old one or by a thinner rope

If the new rope is pulled in by the old one or by a thinner rope one must make sure that the connection between these ropes is absolutely safe. In addition, it must be ensured that the thinner rope cannot rotate. Rotation-resistant steel wire ropes or three-strand fibre ropes for instance, can be recommended for this purpose.

When using conventional wire ropes one must at least make sure that they have the same direction of lay as the rope to be installed.

If the new rope is pulled in with the help of the used one, the two rope ends are often butt-welded together. A connection of that kind can transfer the twist of the old rope, built up in the reeving system, into the new rope. By that method of installation the new rope may be extremely damaged.

There are even more reasons why that procedure is highly problematic: It is true, that when using special electrodes the welded connection presents acceptable results in a pull test with a straight rope; but because of the great length of the rigid connection zone the very same connection could break due to the enormous bending stresses when running over sheaves.

If that connection is applied, its safety should be increased by using a Chinese finger. Fewer problems are caused by connecting wire ropes with welded-on pad eyes or chain links (Fig. 17), which are joined by either strands or thin wire ropes.

This connection provides satisfactory load capacity, it is flexible and prevents the transfer of twist from the old rope into the new one. When using two strands to pull the rope into place, these will indicate the intensity of twist in the old rope on the basis of the number of turns they have made during the installation procedure.

Another possibility is connecting the rope ends with Chinese fingers. These are tubes made out of braided strands, which are pulled over the rope ends and then secured at their ends with tape (Fig. 18). Under load the Chinese fingers will contract and hold the rope ends by friction.

When installing a lang lay rope one must take care that the Chinese finger cannot unwind from the rope like the nut from a screw. It is helpful to wrap a tape around the whole rope length to be held by the Chinese finger to increase the friction.

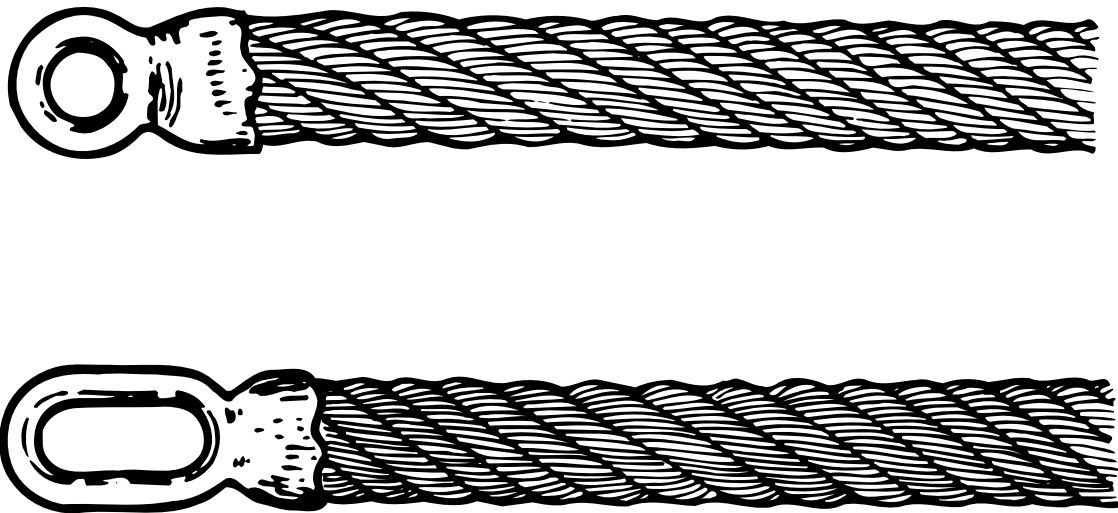


Fig. 17



Fig. 18

2.6. Installing under load

To achieve perfect multiple layer spooling of the rope on the drum it is very important - particularly with the so-called Lebus spooling - to apply a tensioning load to the wire ropes during the installation.

If the first layers are not under tension, they might be too loose, so that the top layers might be wedged into the bottom layers under load. This could seriously damage the rope. The unwinding rope might even be clamped, so that the direction of spooling could suddenly be reversed during the course of unwinding. The result could be the abrupt lifting of the load that was actually travelling downwards.

The tensioning load should range from 1% to 2% of the minimum breaking load of the wire ropes. In many cases it might suffice to wind the rope quite normally in order to unwind it and then rewind it with the help of an outer load. In other cases, however, e.g. when erecting a tower crane that has not yet reached its maximum height, the procedure mentioned above is not possible. In these cases the tensioning load must already be applied when installing the rope.

Ample rope tension can be provided by a simple plank bearing against the reel flanges (Fig. 19) or by a braking disk attached to the reel (Fig. 20). The braking cords (hemp ropes with a steel core) will be provided by the rope manufacturer. Under no circumstances should one attempt to generate the tensioning load by jamming the rope, for instance between two boards (Fig. 21). Structural changes would deform the rope beyond repair.

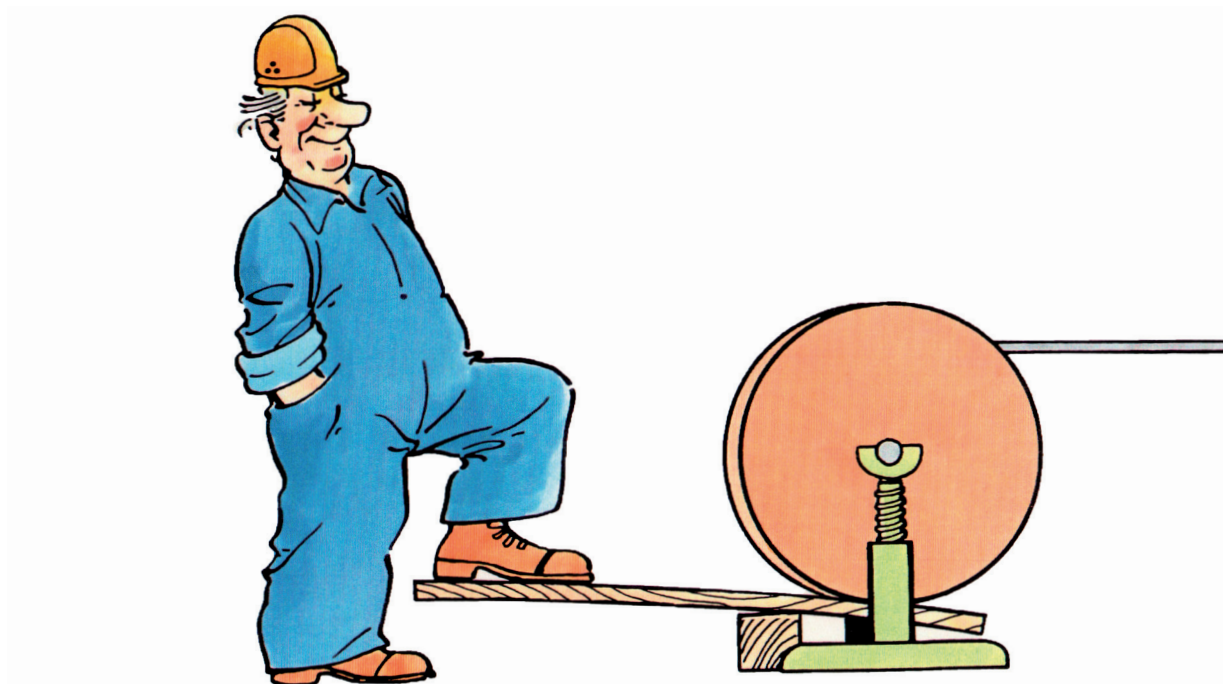


Fig. 19

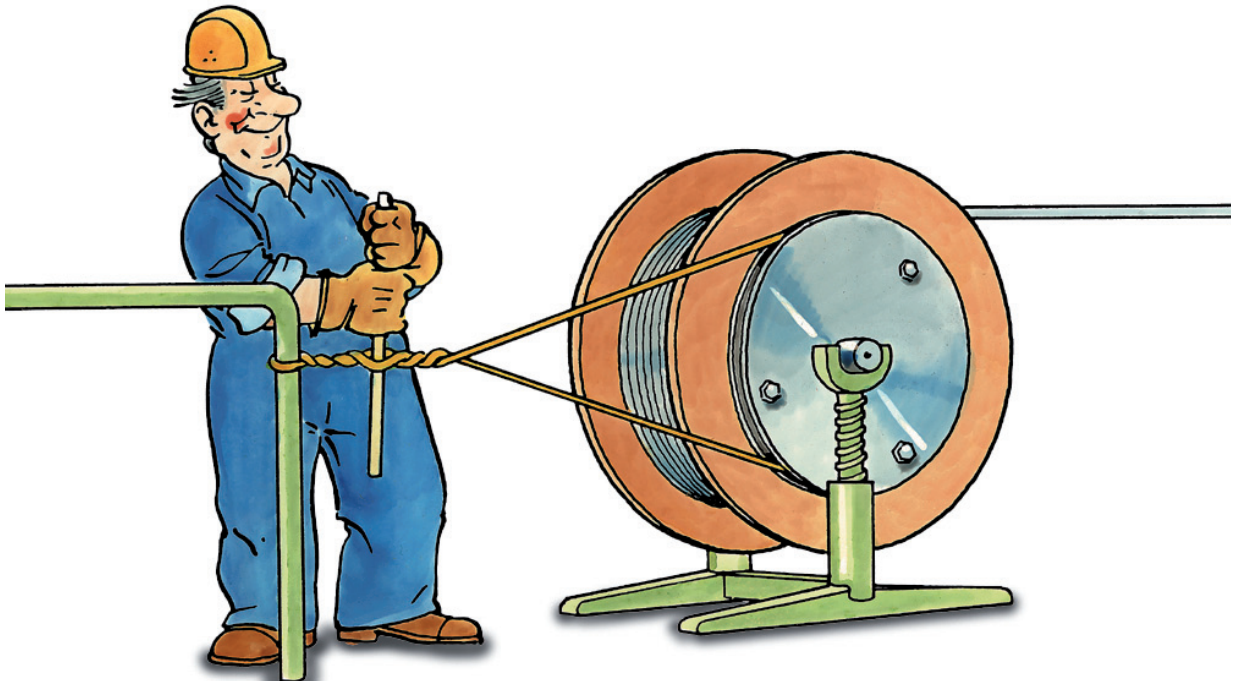


Fig. 20

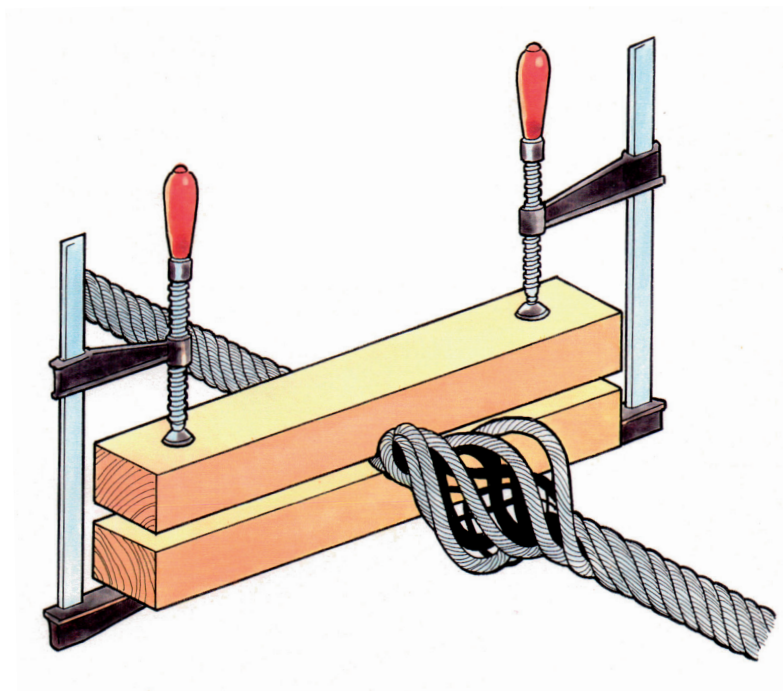


Fig. 21

2.7. “Breaking in” the steel wire rope

After the rope has been installed and before it is going to do its proper job, several run-throughs of the normal operational circle should be carried out under light load. The new rope should be “broken in”, so that the component parts can settle and adjust themselves to the actual operating conditions. It is most unfortunate that in practice only too often the exact opposite of this recommendation is performed: quite frequently after installing the rope overload tests are carried out with loads beyond the safe working load of the system.

2.8. Cutting steel wire ropes

In many cases the user must cut steel wire ropes. Hand cutters are sufficient for rope diameters up to 8 mm. Mechanical or hydraulic cutters will be required for larger sizes.

The best method is to use a high speed disc cutter. Unless the rope is being scrapped the use of flame cutting equipment is not recommended.

Careless cutting can result in the balance of tension in the rope being destroyed. This is particularly important when cutting rotation resistant ropes where the strands may have been deliberately non- preformed as part of the manufacturing specification.

In every case, each side of the cut must be properly seized to prevent strand disturbance. Insulating tape cannot prevent strand movement and annealed (iron) wire should always be used.

After marking the position of the cut the end of the seizing wire is laid along the rope axis leaving sufficient length to secure both ends by twisting when the seizing is complete.

The rope and this wire end are now wrapped moving away from the location of the intended cut (Fig. 22a). The rope is tightly wrapped for a distance of approx. three rope diameters (Fig. 22b).

Both ends of the seizing wire are then pulled tight and twisted together for a length of one rope diameter (Fig. 22c). The twisted connection is then hammered into a strand valley.

After preparing the other side of the intended cut accordingly the rope can now be cut (Fig. 22d).

Instead of using one long seizing it is also possible to apply at least three seizings the size of one rope diameter each on both sides of the intended cut.

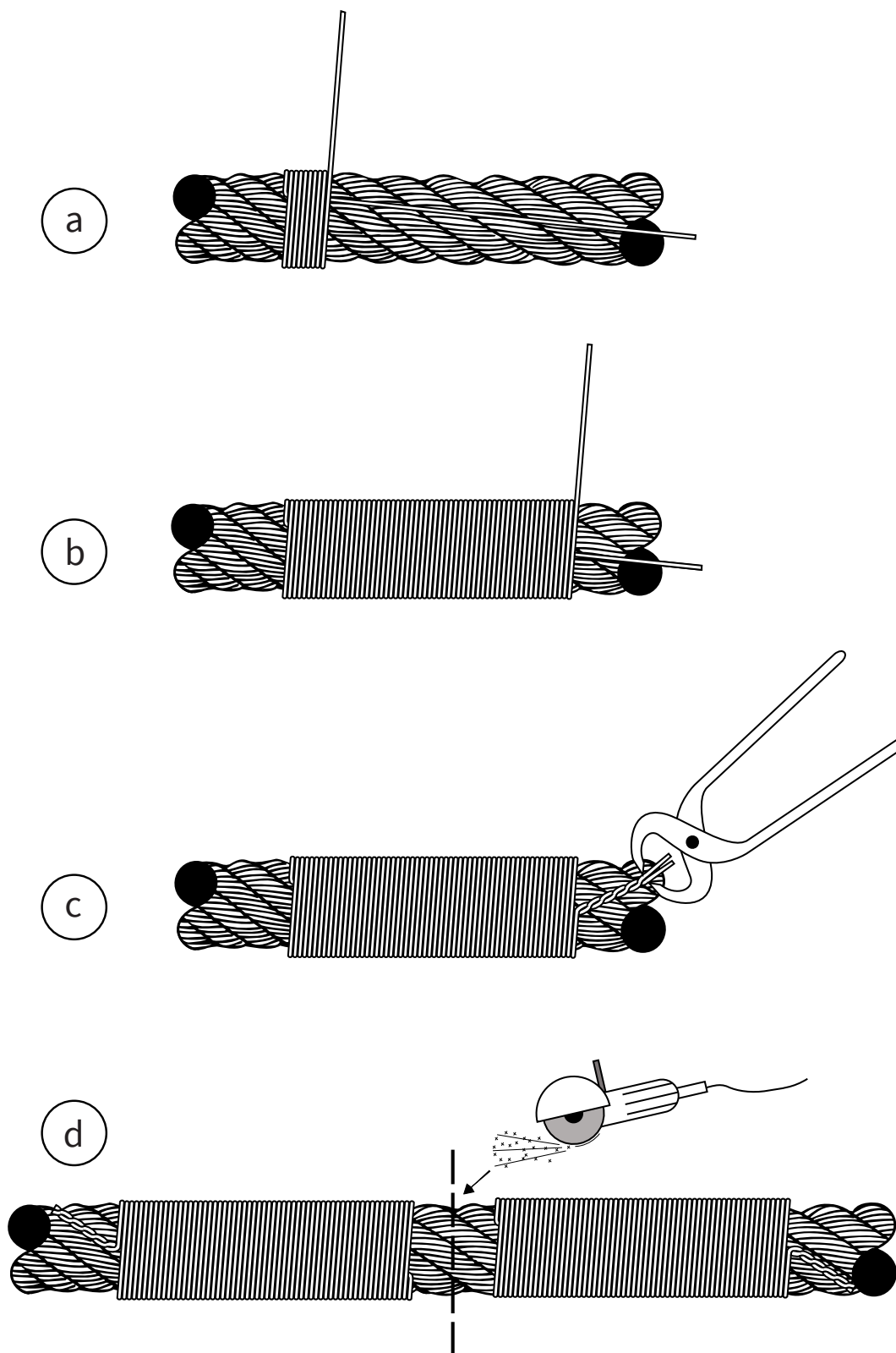


Fig. 22

3. The maintenance of steel wire ropes

Steel wire ropes must be serviced regularly, the kind of maintenance depending on the lifting device, its use and the selected rope. Regular maintenance may considerably increase the service life of a steel wire rope

3.1. Relubricating steel wire ropes

During production the rope receives intensive lubrication. This in-process treatment will provide the rope with ample protection against corrosion and is meant to reduce the friction between the elements which make up the rope as well as the friction between rope and sheaves or drums. This lubrication, however, only lasts for a limited time and should be reapplied periodically.

German Standard DIN 15 020 specifies: “Steel wire ropes must be relubricated at regular intervals, depending on their use, particularly along the zones subjected to bending. If for operational reasons relubrication cannot be carried out, shorter service life of the rope is to be expected and the inspection intervals have to be arranged accordingly.” The influence of lubrication and relubrication on the service life of the rope is illustrated in Fig. 23.

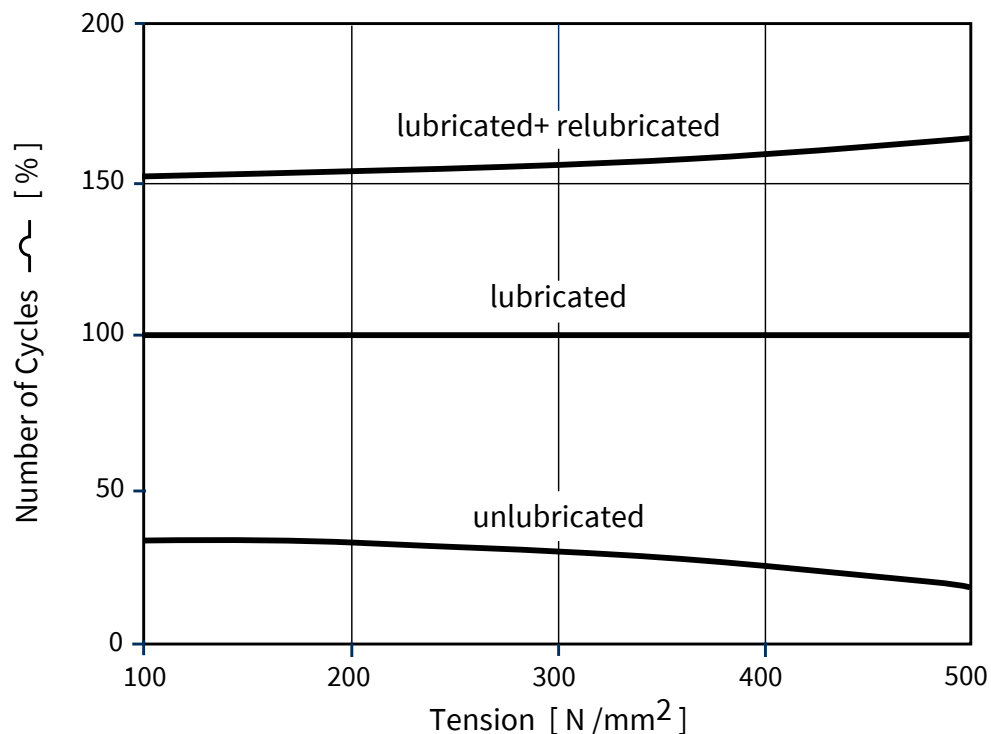


Fig. 23

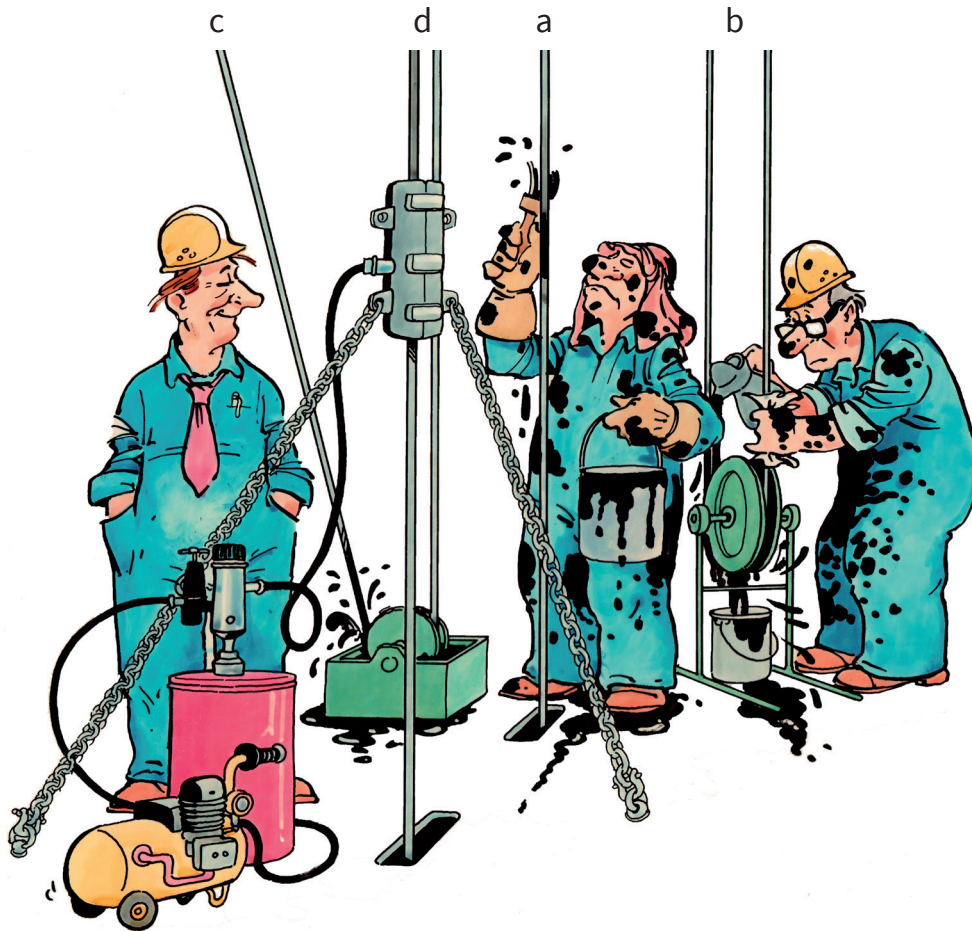


Fig. 24

When choosing the relubricant, it must be ensured that it is in accordance with the recommendations of the rope manufacturer.

There are several techniques of lubricant application: The most common ones at present are painting or swabbing (Fig. 24a).

Quite often the lubricant is applied at a sheave (Fig. 24b), sometimes a continuous drip method is used. If only a little lubricant is required, pressure spray nozzles can be applied.

Various other systems allow the application of a continuous bath (Fig. 24c). Maximum penetration of the lubricant into the gaps of the rope can only be guaranteed if high pressure lubrication is applied with the help of a pressure lubricator (Fig. 24d).

With this method the two halves of a sleeve, which is equipped with rubber sealings, are clamped round the rope and screwed together. While the rope runs through the lubricator the lubricant is pressed into the sleeve at a pressure up to about 30 bars.

It is important with all different methods of relubrication of steel wire ropes that they are carried out regularly right from the beginning of the service life of the rope and not only after the first damage has been ascertained.

3.2. Cleaning steel wire ropes

DIN 15 020 recommends: “From time to time very dirty steel wire ropes should be cleaned externally”. This applies particularly to ropes operating in extremely abrasive conditions and to those that take up chemicals.

Effective cleaning without proper tools is quite a laborious job. For cleaning steel wire ropes the Canadian Rigging Manual recommends an appliance with three rotating wire brushes and an air blast drying system to follow. An American manufacturer offers a “rope porcupine”, a sleeve equipped with brushes, which is drawn along the steel wire rope.

3.3. Removal of broken wires

If during an inspection ends of broken wires are detected which might cross adjacent wires and destroy them when running over sheaves, these broken wire ends must be removed.

Under no circumstances should the broken wire ends be pinched off with a pair of nippers (Fig. 25). The best method is to move the wire ends backwards and forwards until they break deep in the valley between two outer strands (Fig. 26). With thicker wires a tool should be moved backwards and forwards on the surface of the rope, thus bending the wires until they break.

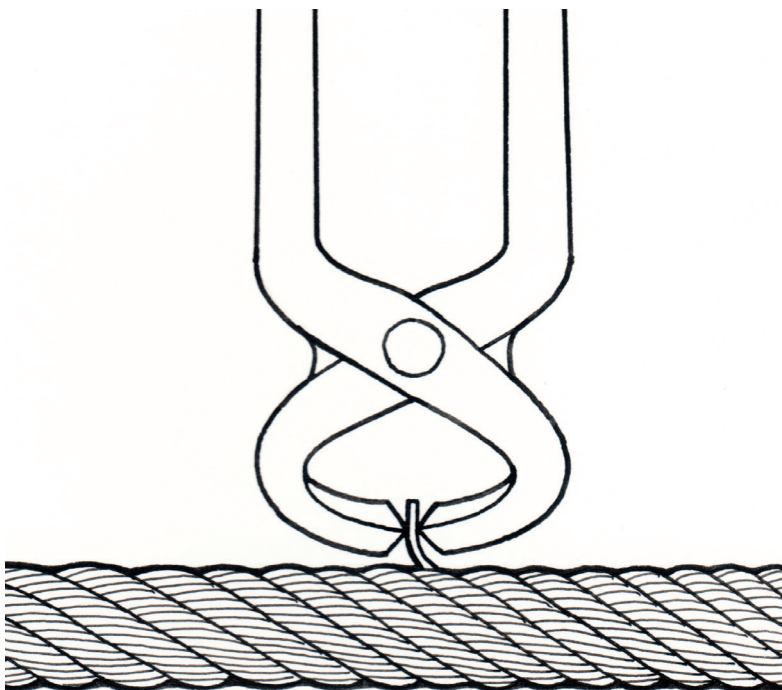


Fig. 25

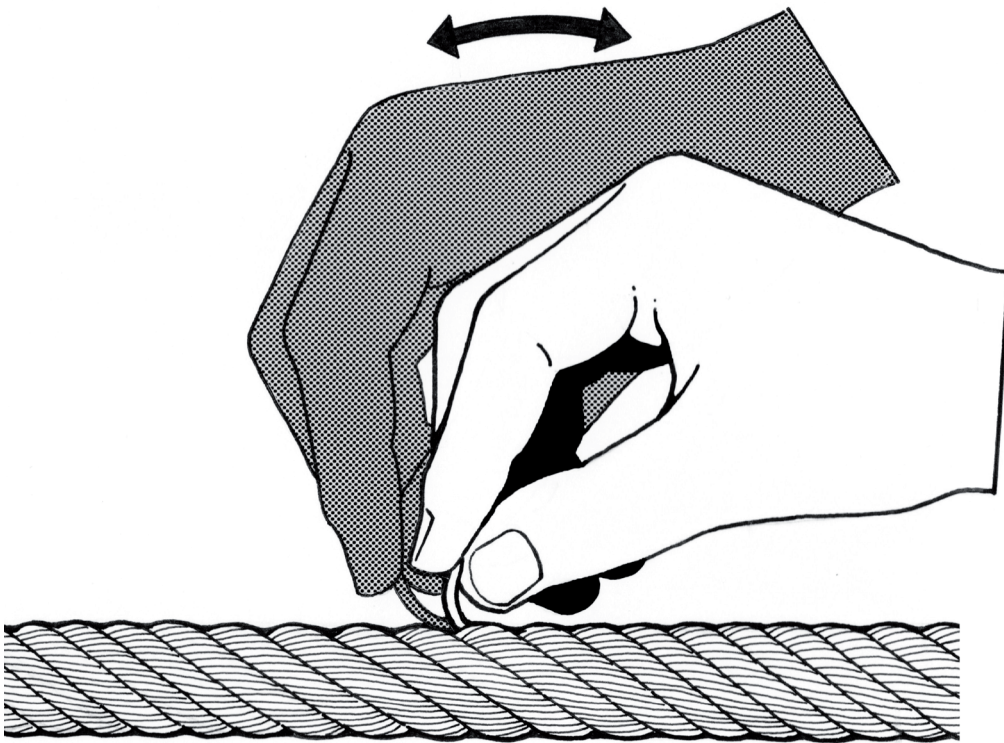


Fig. 26

3.4. Cutting or shifting steel wire ropes

Very often wire ropes must be discarded although only short rope sections, e.g. the one that climbs to the second layer on the drum, are seriously damaged, while the rest of the rope is still in perfect condition.

In cases such as this the service life of wire ropes can be enormously increased by shortening, shifting them at the fixing point by a span that removes the section of the rope which has had most abuse out of the critical zone. After this procedure an adjacent section will be subjected to the abuse.

Another typical local damage occurs on the drum at those sections where the rope rubs against the adjacent winding (crossover point) and must be deflected to the side. If the damage caused in these sections is the main reason for discarding the rope, several cuttings or shiftings will move the stresses to different rope zones and possibly multiply the service life of the rope.

3.5. End- for- ending steel wire ropes

On some machines, various rope sections are subjected to very different stresses. The drag rope of a dragline, for instance, is mainly subjected to bending fatigue at the drum end, whereas the section at the bucket end is subjected to severe abrasion by being dragged through the rubble.

Particularly in the USA and in the UK it is common practice to reverse the rope after a certain time of service (end for ending) so that now the drum end of the rope, which then usually is in better condition, can be subjected to the wear at the bucket end.

The effect of such measures is rather controversial. In any case the expenditure will only pay off, if the value of the rope exceeds the costs of the rope installation.

4. Concluding remarks

For reasons of space this brochure can only deal with general questions of handling, installation and maintenance of steel wire ropes. However, the publisher and the author, Dipl.- Ing. Roland Verreet, would always be pleased to give their opinion on any special problems.

For further editions of this brochure the author will appreciate suggestions for improvements or any comments, if these are addressed to:

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