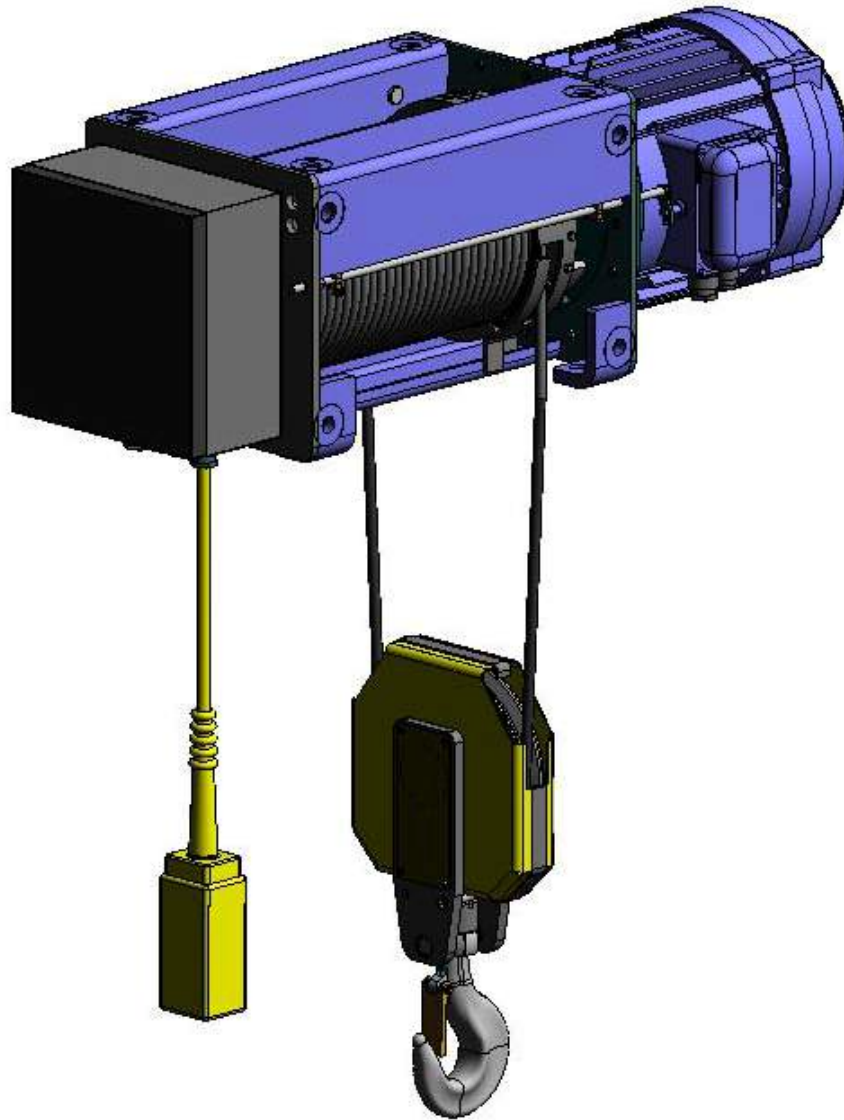




Hydramach Overhead Crane

7662 Industrial Way, Agassiz, BC, Canada V0M 1A2
t 604 796 9221 e integrity@hydramachcrane.com
f 604 796 9227 www.hydramachcrane.com



INSTRUCTION FOR MOUNTING AND OPERATION

ELECTRIC WIRE ROPE HOISTS SERIES **VAT**

**EL
MOT**

ISO 9001:2000 Quality system

CE

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Each electric hoist is accompanied by a separate document “Passport” containing its technical parameters. The present Instruction is an enclosure to the Passport.

1. INSTRUCTIONS TO THE USER AND GENERAL SAFETY REQUIREMENTS



Before starting the hoist operation it is obligatory to read carefully and keep the present Instruction for operation

1.1. GENERAL INSTRUCTIONS TO THE USER

- Following the instructions for servicing and maintenance containing in this document will guarantee you a good condition and reliable exploitation of your electric hoist.
- Please, keep the requirements for safe operation. This would avoid possible hazards for the operating personnel and prevent the electric hoist from damages.
- The electric hoist repair should be done only with original spare parts supplied by the manufacturer and ordered from the Spare parts catalogue, which is enclosed to the Passport.
- Only a qualified electrician should perform connection of the electric hoist to the supply mains in accordance with p. 4.3.
- Only competent specialists authorized by ELMOT JSC should install and put the electric hoist into operation.
- All safety requirements containing in the present Instruction, as well as into the normative documents for work with electric devices and hoisting equipment, which are valid for the country, where the electric hoist is installed, should be kept during mounting and exploitation.
- The present Instruction contains safety requirements, which are in conformity with the European standards, as well as with the requirements of FEM and DIN, as follows:
 - Machinery Directives 89/392 EWG, 91/368 EWG,
 - 93/44 EWG, 93/68 EWG
 - EN 292-1:1991 Sicherheit von Maschinen
 - EN 292-2:1991 Sicherheit von Maschinen
 - EN 60204-1 Safety of machinery - Electrical equipment of machines
 - VBG 8 Winden, Hub und Zuggärete
 - VBG 9 Krane
 - VBG 9a Lastaufnahmeeinrichtung im Hebezeugbetrieb
 - DIN 15018 Grundsätze fuer Stahltragwerke
 - DIN 15020 und FEM Grundsätze für Seiltriebe

1.2. GENERAL REQUIREMENTS FOR SAFE OPERATION



The present Instruction contains safety requirements in its separate parts. Nevertheless, the following specific requirements for safe operation should be kept obligatory:

1. It is forbidden to lift loads and move them overhead operators or other people.
2. Every day before starting operation, check the action of the brake and the limit switch.
3. Do not leave the lifted load without observation.
4. Do not exceed the rated loading capacity.
5. Do not lift loads not perpendicularly or drag them on the floor.
6. Check regularly the wire rope condition and if necessary replace it in due course. When replaced, check if both ends of the wire rope are fixed firmly.
7. After wire rope replacement, electric hoist repair or new mounting, it is necessary to perform once again electric motor “phasing”, as well as limit switch adjusting for upper and lower end positions of the loading hook (see p. 4.4).
8. During exploitation, when the axial rotor run of the electric motor reaches its maximal allowed value, the brake should be adjusted (see p. 5.4).
9. During maintenance or repair of the electric hoist, always observe the following:
 - Do not leave load on the hook;
 - Always switch off the mains breaker and ensure it against erroneous or unintentional switching on.
10. Regularly check the hook for cracks and deformations, as well as the good shape of the device against the load self-unhooking.
11. Check the carrying screw joints in order to prevent possible self-unscrewing.
12. Check the reliable joining of the protective wires of the supply cord, electric motor and transformer.
13. If the electric hoist is with trolley it is necessary to place buffers in both ends of the monorail path (see p. 4.8).
14. If the command commutator (pendant station) is dismantled all metal screw heads, which close its body should be recovered with electro-insulating material.
15. The limit switch should not be used as operative.
16. Do not use the electric hoist to lift loads, which are stuck to the floor (for example frozen).
17. The end positions for upward and downward movement could be used only if there is a working limit switch.

2. USAGE ACCORDING TO THE FUNCTION

2.1. FUNCTION

Electric wire rope hoists series VAT are designed to work as hoisting mechanisms (stationary electric hoists) or hoisting and transporting mechanisms for materials handling (electric hoists with trolley). They could work independently or built into other hoisting equipment. They are intended to operate in premises or in the open under shelter within the technical parameters and working conditions written into each hoist Passport.

The electric hoist is not intended to operate in chemically aggressive environment or at explosion hazard.

The possible risks are estimated and removed in the design process and the user is warned about them in the present Instruction through the instructions for safe operation in accordance with the requirements of VBG8 and VBG9. For user's facilitation some extracts from VBG8 and VBG9 are quoted in parts 4 and 5 of the present Instruction.

To decrease the risks, please keep the following prescriptions:

- The electric hoist should be used only according to its function within the technical parameters pointed out in its Passport. Any deviation from the usage according to the function represents a residual risk.

- The prescribed operation regime should be kept. Do not use a harder duty cycle.

- The user should not allow electric hoist maintenance to be carried out by persons, which are not in conformity with the requirements of the normative documents arranging work with handling equipment valid in the corresponding country.

- The user should control observing all safety requirements related to hoist mounting, first start, service and maintenance, which are included in:

- this Instruction and the normative documents quoted here;
- European norms;
- norms of the country where the hoist is installed and exploited.

All diaries related with checks should be filled in regularly (see p. 4 and 5). All inspection checks must be done in due course in accordance with VBG9, §26 and VBG8, §23.

- ◆ If some devices for load holding are used, they should be started, operated, tested and maintained according to the manufacturer instructions, VBG 9a or the respective local norms.

- ◆ The user must not change the electric scheme or exclude elements from it. The existing buttons and switchers should not be used for other purposes.

2.2. ELECTRIC HOIST CONTROL

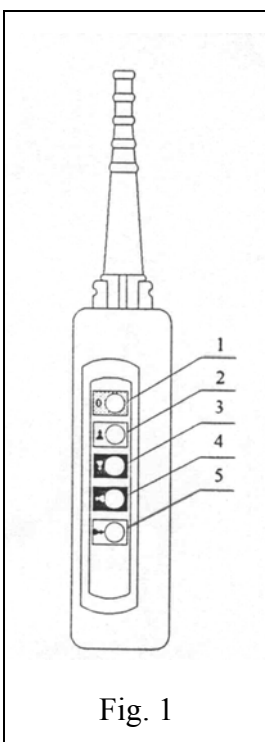


Fig. 1

The control is effected through the buttons of the pendant station.

Fig. 1 shows one of the pendant stations used.

- 1 - Emergency stop-button;
- 2 - Button for upward load movement;
- 3 - Button for downward load movement;
- 4 - Button for left load movement;
- 5 - Button for right load movement.

Usually the emergency button is placed in the top.

Buttons are marked with explanation signs in line with NF E 52-124. Fig. 1 shows a pendant station for electric hoist with trolley. If there is no trolley, the pendant station is with three buttons – items 1, 2 and 3.

Both hoisting and travelling mechanisms could be equipped with one- or two-speed electric motors.

By one-speed motor movement is effected with main speed, by two-speed motor – with main and micro speed. Possible variants are described in p. 4.3.1.

The movement in one direction with main or micro speed is effected by one and the same button, which has two steps:

- at first step the movement is effected with micro speed;
- at second step the movement is effected with main speed.

3. TECHNICAL DESCRIPTION


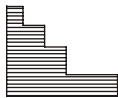
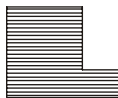
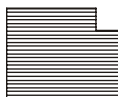
3.1. ELECTRIC HOIST DESIGNATION

HVAT 3511TpE206TNS

Type	...	- without stop button			
	S	- with stop button			
	B	- second brake			
	overload limiter	...	- without overload limiter		
		N	- with overload limiter type NOL		
		V	- with overload limiter type VOL		
	environment	...	- normal		
		T	- tropical		
		M	- marine		
		C	- chemical		
	traveling speed	...	- normal		
		T	- tropical		
		M	- marine		
C		- chemical			
F		- cold zone (-40°)			
01		- 20 m/min, without brake			
06		- 20 m/min, with brake			
08		- 32 m/min, with brake			
11		- 20/5 m/min, with brake			
12		- 32/8 m/min, with brake			
15	- 12/4 m/min, with brake				
16	- 15/5 m/min, with brake				
17	- 20/6 m/min, with brake				
18	- 32/10 m/min, with brake				
19	- 20/10 m/min, with brake				
reeving scheme	E	D			
	1	1/1	2/2-1		
	2	2/1	4/2-1		
type of reeving	3	4/1	-		
	E	- single rope			
thermal protection	D	- double rope			
	...	- without thermal protection			
velocidad de elevacion	Tp	- with thermal protection			
	1/1	2/1	4/1		
	1	16 m/min	8 m/min	4 m/min	
	2	16/4 m/min	8/2 m/min	4/1 m/min	
	3	10 m/min	5 m/min	2.5 m/min	
	4	10/2.5 m/min	5/1.2 m/min	2.5/0.6 m/min	
	5	24 m/min	12 m/min	6 m/min	
	6	24/4 m/min	12/2 m/min	6/1 m/min	
	lifting height	1	H1	6	H6
		2	H2	7	H7
3		H3	8	H8	
4		H4			
5		H5			
1/1		2/1	4/1		
05		0.25 t	0.5 t	-	
15		0.5 t	1 t	2 t	
capacity	25	1 t	2 t	5 t	
	35	1.6 t	3.2 t	7 t	
	45	2.5 t	5 t	10 t	
	55	5 t	10 t	20 t	
	65	-	12.5 t	25 t	
	75	-	16 t	32 t	
	modification	...	- Normal		
A		- diameter rope			
P		- enlargement power			
B		- on the reducer			
constructive execution	...	- stationary			
	H	- with monorail trolley type T			
	H1	- with monorail trolley type XM			
	C	- low headroom			
				K - with double rail trolley	

LIFTING SPEEDS SHOWN IN EUROPEAN 50Hz multiply by x 1.2 TO GET 60Hz FOR NORTH AMERICA

3.2. ELECTRIC HOIST CLASSIFICATION ACCORDING TO THE LOADING DUTY CLASS

Loading class Features			Usage class Average usage time Daily-Tm (h) / Total-Tm (h)		
Light	Operation with medium and rated loads		$\frac{2-4}{6300}$	$\frac{4-8}{12500}$	$\frac{8-16}{25000}$
Medium	Operation with medium and rated loads		$\frac{1-2}{3200}$	$\frac{2-4}{6300}$	$\frac{4-8}{12500}$
Hard	Usual operation with rated and close to rated loads		$\frac{0.5-1}{1600}$	$\frac{1-2}{3200}$	$\frac{2-4}{6300}$
Very hard	Constant operation with rated and close to rated loads		$\frac{0.25-0.5}{800}$	$\frac{0.5-1}{1600}$	$\frac{1-2}{3200}$
Cyclic duration factor , %			30	40	50
Number of operations per hour ,h ⁻¹			180	240	300
Designation			4	5	6
Operation mode group as per GOST 25835 FEM 9.551/DIN 15020 ISO 4301			2M 1Am M4 (4)	3M 2m M5 (5)	4M 3m M6 (6)
Reeving scheme			Hoist size	Type	
1/1	2/1	4/1			
Capacity, kg			VAT 05	VAT 05	
250	500	1000			
320	630	1250	VAT 10		VAT 16
400	800	1600			
500	1000	2000	VAT 20	VAT 15	
630	1250	2500		VAT14	
800	1600	3200	VAT 30		VAT 26
1000	2000	5000			VAT 25
1250	2500	5000	VAT 40	VAT24	VAT 36
1600	3200	7000			VAT 35
2000	4000	8000	VAT 50	VAT34	VAT 46
2500	5000	10000			VAT 45
3200	6300	12500	VAT 60	VAT44	VAT 56
4000	8000	16000			VAT 55
5000	10000	20000		VAT54	VAT 66
6300	12500	25000		VAT 65	
8000	16000	32000		VAT64	

3.3. ELECTRIC HOIST MODIFICATIONS DEPENDING ON THE CLIMATE

ELMOT manufactures electric hoists in climatic modifications as per IEC 721-3 (DIN IEC 721T3) for climatic zones as per IEC 721-2-1, p.5.3, listed in Table 1.

Table 1

No.	Climatic Zone	Climatic modifications	
		Category according to position in exploitation	Designation
1	Normal	Work under shelter	N - II
2	Tropical	Work under shelter	T - II

The term *under shelter* means that the following climatic factors have impact on the product: solar radiation and rain.

Electric hoists could also operate in premises. The climatic factors impact is: no direct influence or substantially reduced influence of environment – solar radiation, rains, dust and sand, wind, sharp temperature changes, etc. In many cases the temperature inside premises is lower than in the open air or under shelter

Climatic modification is written in the hoist Passport.

The machine is protected against penetration of articles and liquids conforming to IEC 529 and DIN 40050 and in accordance with p. 13.3 of EN 60204-1:1992. Protection degree is pointed out in the Passport. Generally, the different hoist modules have protection degree not lower than: command commutator (pendant station) – IP 65, electric control panel – IP 54, electric motor terminal box – IP 54.

3.3.1. Electric hoists for normal climatic zone

They operate in environment conditions according to the requirements of EN 60204, p. 4.4: air temperature from -20°C up to $+40^{\circ}\text{C}$; relative air humidity - from 30% up to 95 %; elevation above sea level – up to 1000 m.

If altitude is over 1000 m it is considered that decreasing the environment temperature could compensate the reduced cooling resulting from the decreased air density. For electric motor insulation class F the admissible air temperature depending on the altitude is, as follows:

Altitude, m	from 1001 to 2000	from 2001 to 3000	from 3001 to 4000
Air temperature, $^{\circ}\text{C}$	+30	+ 19	+9

3.3.2. Electric hoists for tropical climatic zone

They operate in environment conditions according to the requirements of EN 60204, p. 4.4: air temperature from -15°C up to $+40^{\circ}\text{C}$; relative air humidity - from 30% up to 95 %. Compared to electric hoists for normal climatic zone the constructive difference is in the materials used.

The protective varnishes and metal holdings are suitable for the tropical climatic zone.

In the mechanical part of the electric hoist are used metals and alloys with increased resistance against corrosion. All remaining metal details and parts are protected against corrosion by appropriate holdings.

The electric motors and the control appliances built-in are manufactured with climatic protection T, class II. The insulation materials are resistant against heat and moisture and possess the necessary mechanic strength. The protective and impregnation varnishes are also resistant against heat and moisture. They form solid holdings and still have enough elasticity.

The electric motors and the control appliances are designed to work in climatic zone with the following characteristics: high humidity, availability of biological factors, air containing dust, sand particles, and aerosols.

3.4. ELECTRIC SUPPLY

The electric supply is three-phase from electric mains with rated voltage 380V (400V) and rated frequency 50 Hz, in conformity to § 50 of DIN 0530, part 1.

Electric hoists with different supply voltage (up to 660V) and different rated frequency could be manufactured on client's request.

In accordance with Bulgarian standards electric motors ensure normal operation of the hoisting and travelling mechanism at rated loading when electric mains parameters are, as follows:

- supply voltage: $\pm 10\%$ of its rated value; frequency: $\pm 5\%$ of its rated value;
- if voltage and frequency have simultaneous deviations from their rated values, then the sum of the deviation absolute values should not be bigger than 10 %.

3.5. ELECTRIC HOIST CONSTRUCTION

Electric hoists are designed and tested in accordance with the requirements of Bulgarian state standards (BDS), the rules for calculation of hoisting mechanisms construction created by the Federation of European manufacturers of handling equipment (FEM), as well as some specific regulations of ISO, DIN, IEC, and EN.

In general, the electric hoist consists of three main units – hoisting mechanism, travelling mechanism and control block. When there is no travelling mechanism, then the electric hoist is stationary.

Depending on the exploitation needs the stationary electric hoists could be mounted on horizontal or vertical plane in standing, pending or lateral position.

Depending on the mutual position of the hoisting and traveling mechanisms there are two modifications:

a) normal headroom electric hoists – the hoisting mechanism is situated below the travelling mechanism (Fig. 3);

b) low headroom electric hoists – the hoisting mechanism is situated alongside, at the level of the travelling mechanism. This construction enables decreasing the distance between the point, where the load is hanged on the hook, and the surface, where trolley wheels are rolling over (operation height) (Fig. 4).

3.5.1. Hoisting mechanism

The hoisting mechanism consists of the following separate construction units:

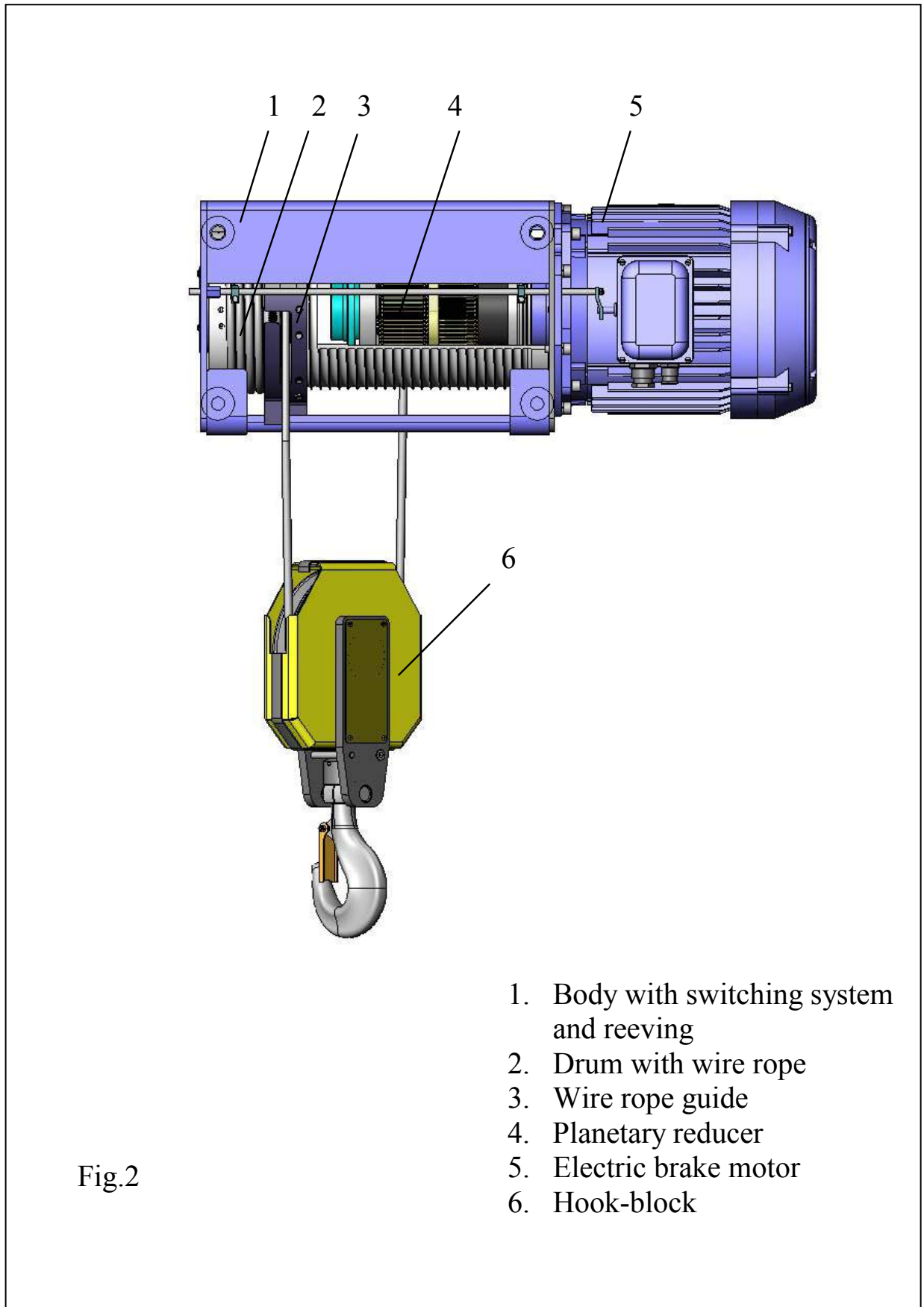


Fig.2

3.5.1.5. Electric brake motor

The hoisting mechanism is driven by an asynchronous brake motor with conical rotor. The brake is actuated under the pressure of helix spring. When connected to the mains the electric motor receives torque, which rotates the motor and also axial electromagnetic force, which moves the rotor axially and the brake is released.

If two-speed motor is built-in, then load could be lifted with main or micro speed.

On request the electric motor could be manufactured with thermal protection

3.5.1.4. Planetary reducer

The motor high speed of revolution is reduced to the required drum revolutions by means of two-step planetary reducer. It is situated into the drum, which makes the hoist more compact and prevents the reducer from undesired environment influence.

All tooth gears in the separate reducer steps are manufactured by high quality steel with appropriate heat processing. Gears are born by ball bearing and lubricated with grease.

3.5.1.2. Drum

The drum is driven through involute groove joint centrically supported by a hollow shaft, which comes out of the second step of the planetary reducer.

From one side the drum is born by the body by means of bearing bracelet, and from the other side – by stopping bush immovably fixed through groove joint to an additional flange on the body.

The screw channels, where wire rope is wound, have profile in accordance with the requirements of FEM and DIN.

3.5.1.3. Wire rope guide

It is made of two functional elements – guiding ring nut and pressing spring. They ensure the correct wire rope guiding and winding into the drum channels.

3.5.1.1. Body (corpus)

The body is the incorporating and carrying unit of the whole hoisting mechanism. It is a complete welded construction formed by two steel flanges connected to profiled girders in length.

The accepted geometrical form is very convenient for building the hoist into other mechanisms without need of additional elements. It gives also enough possibilities for wire rope to have outlet from the drum.

3.5.1.6. Hook - block

Different hook-block constructions for the different reeving schemes ensure the necessary reliability at transmitting the strength from load through hook and carrying elements towards the wire rope branches. The block semi-covers possess the necessary strength and hardness and protect the rolls against hitting hard objects.

The roll channel, roll diameter and the overall hook dimensions are designed in accordance with FEM 9.661, FEM 9.511 and DIN 15020.

3.5.1.7. Control block

The control block is a separate mounting unit, which includes electric control panel and command commutator (pendant station). The control panel contains: contactors for control of the hoisting and travelling mechanisms, reducing transformer and some other elements.

The operative circuit voltage is safe – 42 V (or 24 V). It is obtained by the reducing transformer.

The electric hoist control is performed by means of pendant station with buttons. There is electrical and mechanical blockage between the buttons for different movement directions of the hoisting and travelling mechanisms.

An automatic breaker is placed into the operative circuit in order to prevent short circuits. There could be placed two breakers on client's request. A limit switch for both hook movement directions is connected in the same circuit. When the first step of the limit switch is actuated for one direction, the hook could move only in the opposite direction. When the second step is actuated, the hook movement is blocked in both directions.

The emergency stop-button could be excluded on client's request. Then in the electric schemes on Fig.8 up to Fig.13 the main contactor KO misses.

In the control block could be included the following extras: secret key, overload limiter, thermal protection.

3.5.2. Travelling mechanism

A travelling mechanism for horizontal load movement could be mounted to the hoisting mechanism.

Depending on the exploitation needs the travelling mechanisms are designed for monorail or double rail paths. There are following types of joining between the hoisting and the travelling mechanisms::

a) Swinging trolley – the hoisting mechanism could swing in certain limits around an axis parallel to the rail path.

b) Movable trolley - the hoisting mechanism could swing around an axis parallel to the rail path and additionally the trolley wheels could rotate around a vertical axis.

c) Firm trolley at normal headroom, reeving 2/1 or 4/1: the hoisting mechanism is mounted below the travelling mechanism (Fig. 3).

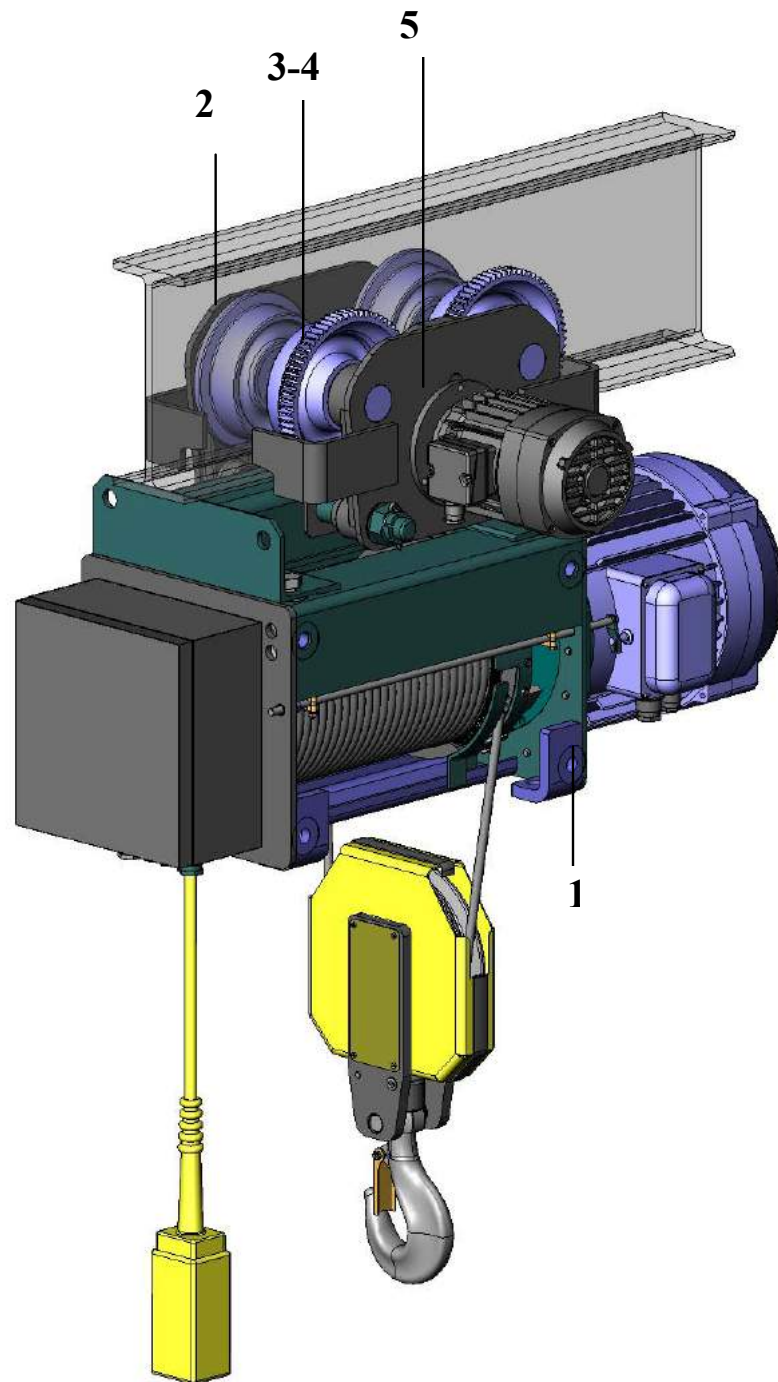
d) Firm trolley at low headroom, reeving 2/1 or 4/1: the hoisting mechanism is mounted alongside the travelling mechanism and thus the hook path is increased (Fig. 4).

e) Hoisting mechanism with travelling mechanism for double rail path.

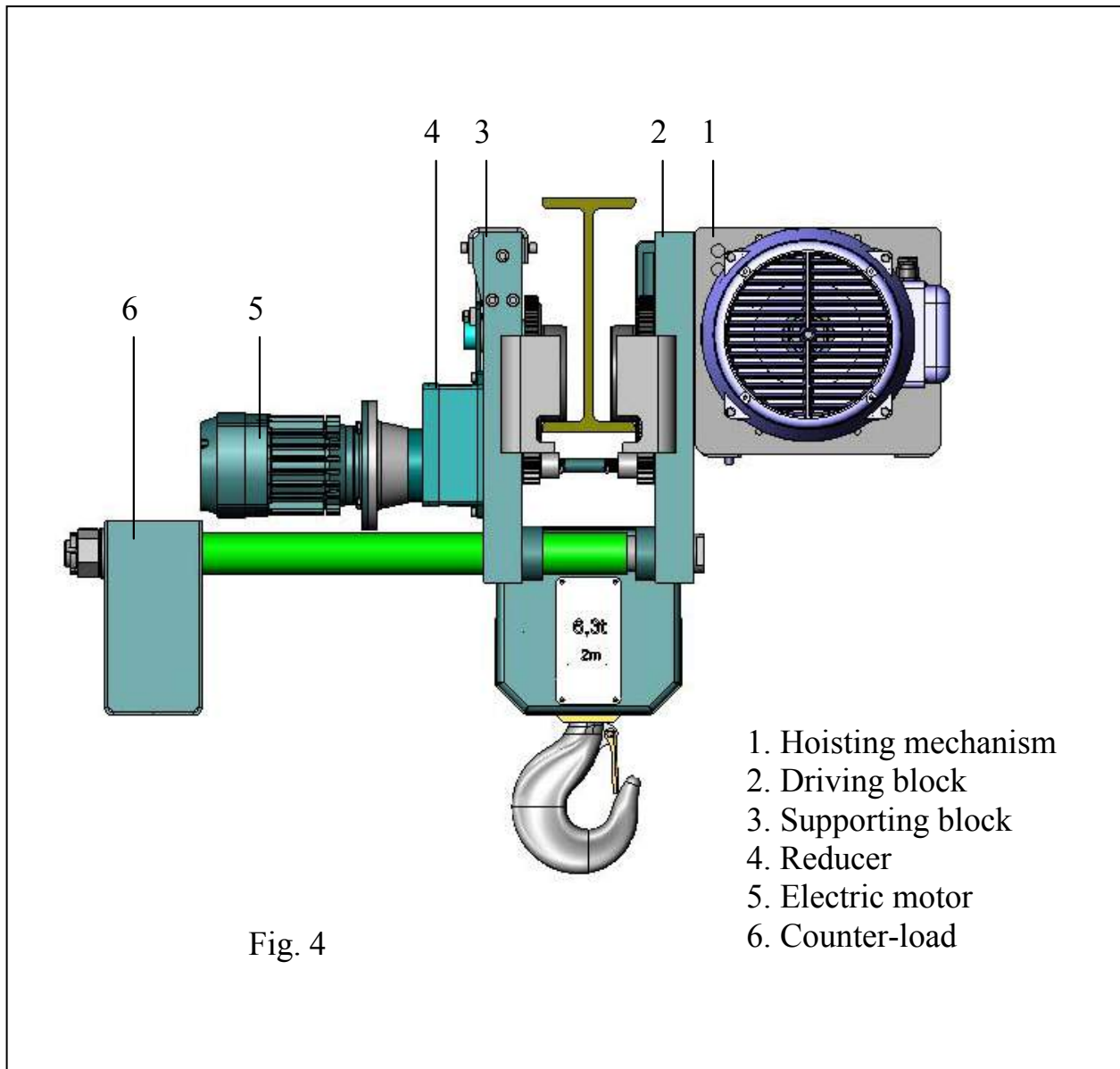
The travelling mechanism construction could be used for monorail paths made of standard profiles as per DIN 1025 with different girdle width "b" (from b= 90 up to b=300 mm.).

Figures 3 and 4 show travelling mechanism construction, which includes: supporting block 2, driving block 3, reducer 4 and electric motor 5.

If the electric hoist is low headroom modification, then a counter-load (pos. 6) is mounted.

**Fig.3**

1. Hoisting mechanism
2. Driving block
3. Supporting block
4. Reducer
5. Electric motor



3.5.3. Electric hoist extras

On request in the electric hoist could be included the following extras: secret key, overload limiter, thermal protection, emergency stop-button. .

3.5.3.1. Secret key

The secret key protects the hoist against undesired switching on.

3.5.3.2. Thermal protection

Thermal elements are built into the electric motor windings – one for each phase. The thermal element is bimetallic and electrically insulated from the motor winding. When the preset temperature is reached the thermal element switches off its normally closed contacts. The contacts of the three thermal elements are serially connected. Thus, if one element is actuated, the upward movement is switched off. Only downward movement remains possible. After the electric motor is cooled, the upward movement becomes available again.



When thermal protection is actuated the load could be moved downwards only with main speed and at minimal number of switches.

3.5.3.3. Emergency stop-button

The emergency stop-button switches off the main contactor KO (Fig.8 ÷ Fig.13) in case of emergency.

3.5.3.4. Overload limiter

The overload limiter blocks the upward movement when the operated load exceeds the rated load with 10%.

Because of the different overload limiter types, if there is an overload limiter mounted on the hoist, its Instruction for operation is enclosed to the present Instruction.

4. MOUNTING AND STARTING THE HOIST OPERATION



Before mounting and starting operation the hoist should be observed visually for possible mechanical damages occurred during transportation.

4.1. MOUNTING REQUIREMENTS

During the process of design and planning the hoist mounting all safety requirements should be kept. According to VBG9 § 11, in order to avoid hazard of contusion or cutting, all exterior parts of the electric hoist, except of the carrying and load-taking devices, should be situated at safe distance of at least 0.5 m from the other objects e.g. buildings or parts of buildings (hall pillars), pipes, machines stored materials, etc.

Some quotes from VBG9 and VBG8 are included in Table 2.

Table 2

Requirement	Document	Quotes from the document
Safe distances	VBG9	§32. The enterpriser should take care that the stationary or travelling cranes are situated at safe distance of at least 0.5 m from their exterior moving parts to the materials stored.
Mounting requirements	VBG9	§40 /1/. The enterpriser should take care that the travelling cranes are exploited only mounted on a base, which is able to support the necessary load. /3/. The enterpriser should appoint a person in charge to supervise dismantling and transporting of movable cranes in accordance with their weight and dimensions and following the manufacturer's instructions.
	VBG8	§25. At crane mounting the operator's seat should be situated or protected in such way, that the operator is endangered neither by the machine and auxiliary devices, nor by the load carried.
	VBG8	§31. If the operator's seat should be abandoned during load handling, then the hazard zone below the hanging load should be protected.



If hoist is controlled by the floor then the operator should have free passage for movement along the hoist path.

4.2. TRANSPORT AND STORAGE

4.2.1. Packing

The packing preserves and protects the electric hoists against mechanical damages or undesired climate influence during transport and storage. It is made by wood.

The packing is in accordance with the transport means and modes, as well as the conditions of the climatic zone (classification as per IEC 721-1-2) where transport is effected.

The following requirements should be kept when manipulating packed hoist: to be protected against mechanical damage; packages to stand only on their base; to be kept away from moisture; to be moved by load-taking device only caught at the determined places (its basement). The packing is designed for manipulation with high fork-lifter.

4.2.2. Transport

The packages should be arranged closely in the transport vehicle. If the transport vehicle is not full, additional fixing should be done. Loading in several rows is allowable only if packages are strong enough to support the load above them.

The road transport vehicles should be covered.

The transport and storage conditions according to EN 60204-1:1992 p. 4.5 are :

- temperature from -25°C up to +55°C; for short period (not longer than 24 hours) it could be up to +70°C.

During transportation other loads should not be placed onto the hoist packages.

4.2.3. Unpacking

Unpacking should be done in the following way – the fixing nails are removed carefully and the plastic stuff is put away. All elements fixing the hoist to the wooden case basement are removed. During unpacking special attention should be paid to the pendant station, the cable and the hook-block.

4.2.4. Storage

Electric hoists should be stored packed and conserved in warehouses at temperature from -25°C up to +55°C.

Unpacked electric hoists could be stored only in production premises or closed warehouses at normal humidity.

If the hoist has been exploited it should be conserved before storage.

4.2.4.1. Conservation

a) Conservation of electric hoists for normal climatic zone

All unprotected metal parts should be lubricated with consistent lubricant Aralub FDPO, BP Energrease HT- EPOO or other corresponding lubricants.

b) Conservation of electric hoists for tropical climatic zone

If electric hoist tropical modification is stopped from operation for more than three months, all its parts exposed to corrosion must be conserved before storage.

Conservation should be carried out in a clean premise without availability of dust or vapours. The environment temperature should be from +10°C up to +25°C and the relative air humidity - between 50 and 60 %. Before starting conservation the hoist should be left into the premise for several hours in order to avoid condensation on its surfaces.

Before laying the conservation material all hoist surfaces should be cleaned from dust, paint residuals, oil, dust and other pollution.

In order to restrain influence of the aggressive climatic factors, the hoist should be packed after conservation.

The electric hoists tropical modification and their spare parts are conserved with different materials depending on the period for conservation. The periods are, as follows:

Up to 3 years – Water solution of natrium nitrate (20-25% for steel and 25-30% for cast iron) is laid on the previously cleaned from oil surfaces. After solution dries a conservation lubricant is laid above.

Conservation lubricants: GOI - 54 (GOST 3276-54), TSIATIM 201 (GOST 6267-74), AMC-3 (GOST 2712-52), Aralub FDPO, BP Energrease HT-EPOO, Esso Getriebfließfett, Shell Special H, Mobil Gargoyle Fett 1200 W.

Up to 2 years – A conservation lubricant is laid on the previously cleaned from oil surfaces.

Conservation lubricants: GOI - 54 (GOST 3276-54), TSIATIM 201 (GOST 6267-74), AMC-3 (GOST 2712-52), Aralub FDPO, BP Energrease HT-EPOO, Esso Getriebfließfett, Shell Special H, Mobil Gargoyle Fett 1200 W.

Up to 1 year - A conservation lubricant is laid on the previously cleaned from oil surfaces.

Conservation lubricants: TSIATIM 203 (GOST 8773-58), TSIATIM 221 (GOST 9433-60).

Before laying all conservation lubricants should be heated to temperature from 110°C to 120°C and rested for 1.5 or 2 hours in order to evaporate the possible content of moisture.

The conservation lubricant should be laid with brushes, special revolving sprays with heater or by other means ensuring quality and reliable conservation. When brush is used, the conservation lubricant layer should be dried with hot gas e.g. by means of benzene lamp. During this operation the lamp should be held at such distance that only gases, not flames, reach the lubricant layer. Thus a complete interaction is achieved and the conservation is as qualitative as that achieved by using a revolving spray.

It is very important that all conservation operations – cleaning, laying the conservation lubricant, packing – are performed consequently and without delay in time.

4.3. CONNECTING TO THE ELECTRIC MAINS

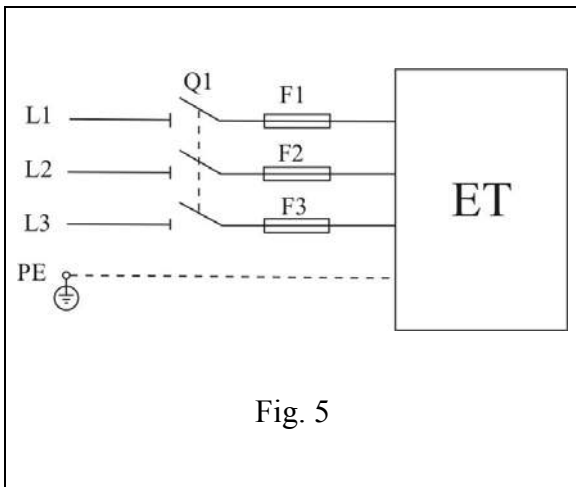


Fig. 5

The electric hoist should be connected to the mains in accordance with the electric scheme attached. Before connection, please check if voltage and frequency written on the hoist label correspond to the electric mains used.

Connection of the electric hoist to the mains should be done by use of:

- principle electric scheme adhered to the inner part of the control panel cover;
- principle scheme for connection of the electric hoist to the mains (Fig. 5)

The hoist is joined to the mains by means of diverger Q1 and fuses F1, F2, and F3.

The diverger disconnects the unloaded electric circuit when the electric installation is repaired or hoist maintenance is performed. A breaker, which disconnects all phases simultaneously, should be used as diverger. It is recommended the breaker to be placed in the electric distribution board of the production premise or to be mounted in place hard to be reached.

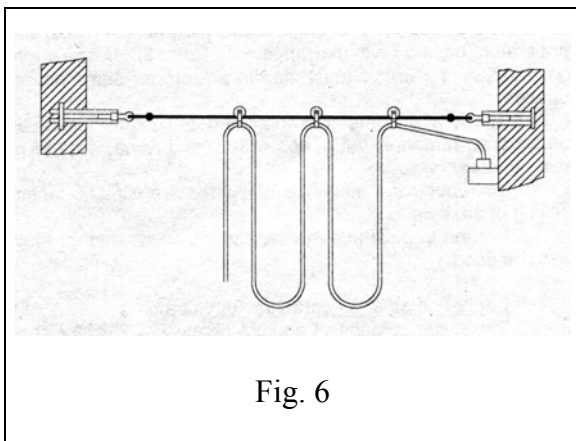


Fig. 6

The electric supply from the breaker to the hoist is through a cable (Fig. 6).

Cables with rubber insulation should be used as movable cables, such are:

- H07RN-F
- H05RN-F
- or combination between them.

As unmovable cables should be used:

- NYMJ
- NYYJ
- or combination between them.

Table 3 contains the necessary rated currents of the main fuses F (F1, F2 and F3 at Fig. 5), as well as the section of supply cable wires, through which the electric hoist is connected to the mains.

Table 3

Electric Hoist Size	Lifting speed m/min		Fuse Rated Current [A]			Max. Length of Supply Cable, m										
						500V		380V				220V				
	2/1	4/1	500 V	380 V	220 V	2.5	4	2.5	4	6	10	2.5	4	6	10	
VAT 10	8	4	6	10	16	138		106				61				
	12	6	10	10	16	138		106				61				
	8/2	4/1	10	10	20	138		106				61				
	12/2	6/1	16	16	25	136		103				59				
VAT20	8	4	16	20	25	76		58				33				
	12	6	20	25	35	69		53				30				
	8/2	4/1	20	25	35	93		71				41				
	12/2	6/1	25	35	50	80		61				35				
VAT30	8	4	16	20	25	69		53				30				
	12	6	35	50	63	48		37	60			21	34			
	8/2	4/1	25	35	63	55		42	68			24	39			
	12/2	6/1	35	50	63	68		52	75			30	43			
VAT40	8	4	25	35	63	34		26	42			15	24	32		
	12	6	50	63	100	-		22	36			-	20	28		
	8/2	4/1	35	50	80	-		35	56			-	32	43		
	12/2	6/1	50	63	100	-		26	44			-	25	34		
VAT50	8	4	63	100	200	-		-	32	45		-	-	25		
	12	6	63	100	200	-		-	32	45		-	-	25		
	8/2	4/1	63	80	125	-		-	-	33		-	-	-	19	
	12/2	6/1	100	125	200	-		-	-	33		-	-	-	19	
VAT60	5	2.5	63	100	200	-		-	32	45		-	-	25		
	8	4	63	100	200	-		-	32	45		-	-	25		
	5/1.3	2.5/0.65	63	80	125	-		-	-	33		-	-	-	19	
	8/1.3	4/0.65	100	125	200	-		-	-	33		-	-	-	19	

At voltages different from those in Table 5 the following methodology is applied:

The fuse rated current is determined by the total current I_m , which is a sum of all electric motor currents. The motor currents are written on their labels and in their Passports. The cable section and the cable length L_K are calculated, as follows:

a) The cable section is calculated from the total current I_m and the received value is approximated to the nearest standard value above.

b) The cable length is determined from the requirement for minimal voltage drop using the functions $I_m = f(L_K)$ calculated by the manufacturer for constant values of cable wires sections (see Fig. 7).

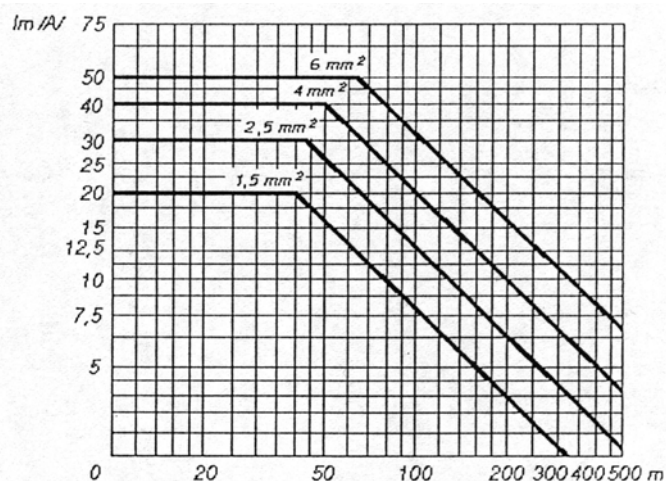


Fig. 7

- The total current value is marked on the vertical axis of the function $I_m = f(L_K)$ (Fig. 7). From the point marked a parallel line is drawn until it intersects one of the drawings, above which a cable wire section is written (1.5 mm^2 , 2.5 mm^2 , 4 mm^2 и 6 mm^2);

- From the received point of intersection a perpendicular line is drawn until it reaches the horizontal axis. The received value is the supply cable length L_K at the corresponding cable section.

If the parallel line does not intersect the function $I_m = f(L_K)$ of the calculated in p. a) cable section, then the next bigger section value is taken.

Connection of the protective wire

The protective wire of the supply cable is connected with the grounding terminal. This grounding terminal is marked with "PE".

The remaining grounding terminals are marked with the grounding sign – sign number 417 as per IEC 5019.



Right after the electric hoist is connected to the mains a check of the correct phase order should be performed in accordance with p. 4.4.

4.3.1. Principle electric schemes

In general, reversive contactor schemes are used for the electric hoist control. The principle electric schemes are shown on Figures 8, 9, 10, 11, 12 and 13.

The principle designations used are, as follows:

L1, L2, L3 – mains phases

St – emergency stop-button

Tr – transformer of operative circuit

Q1, Q2, Q3 – automatic breakers

KO – main contactor

KП – command commutator (pendant station), whose buttons have the following functions:

- button for movement "UP";
- button for movement "DOWN";
- button for movement "RIGHT";
- button for movement "LEFT".

KН – limit switch

~ M – electric motor

1K - 7K – contactors

B1, B2 – block with overload limiter sensors

YOT – electronic block of overload limiter

The contactors function is indicated in the principle schemes by placing the following symbols below the windings:

Symbol	Contactor Function
↑↑	Contactor for movement "UP" with main speed
↑	Contactor for movement "UP" with micro speed
↓↓	Contactor for movement "DOWN" with main speed
↓	Contactor for movement "DOWN" with micro speed
→→	Contactor for movement "RIGHT" with main speed
→	Contactor for movement "RIGHT" with micro speed
←←	Contactor for movement "LEFT" with main speed
←	Contactor for movement "LEFT" with micro speed
↔	Contactor for movements "LEFT" and "RIGHT" with main speed

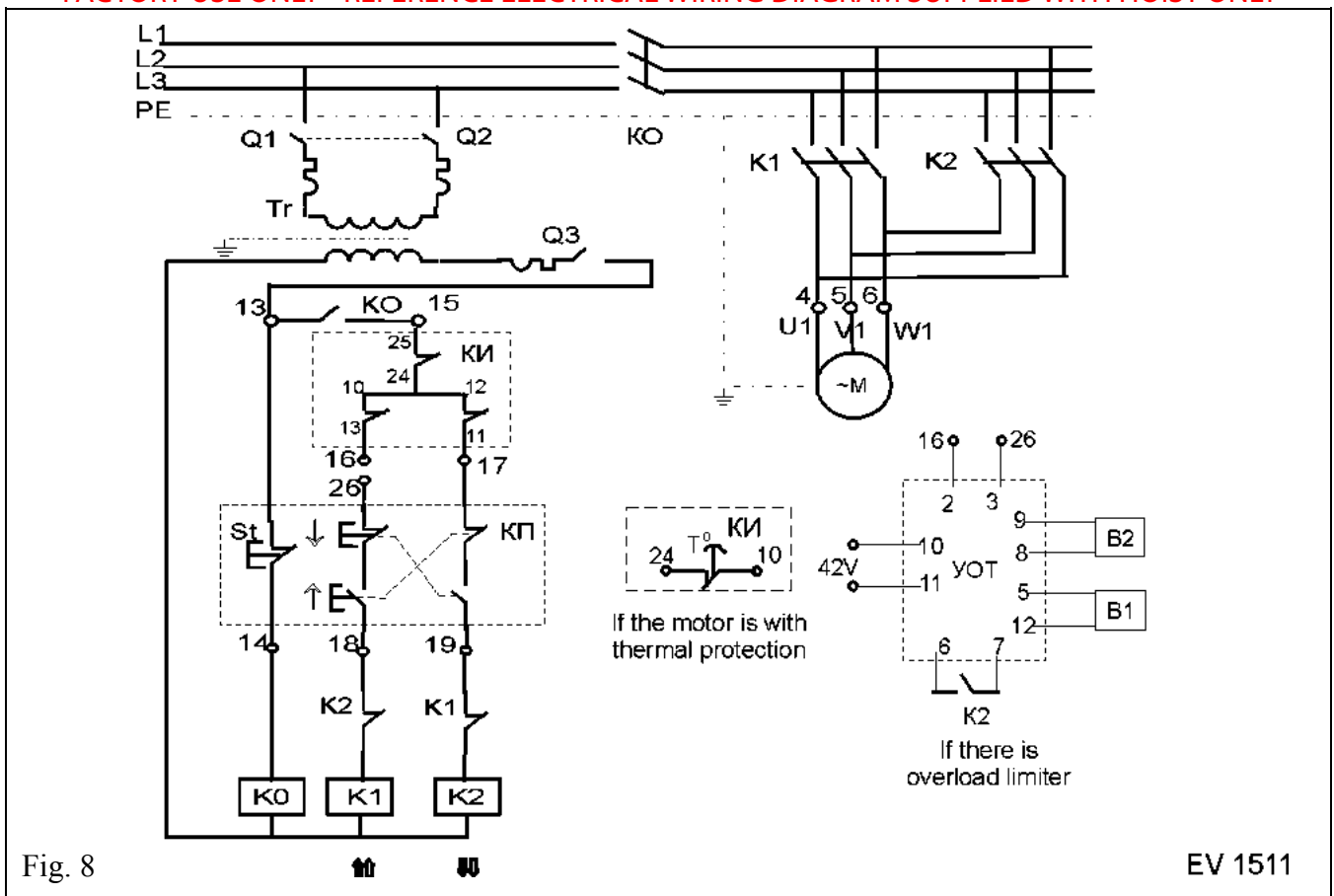
The symbols below motor designations mean:

↑ ○ ↓	Electric motor of the hoisting mechanism
←○→	Electric motor of the travelling mechanism

a) Principle electric scheme

Stationary electric hoist
Vertical movement with main speed

FACTORY USE ONLY - REFERENCE ELECTRICAL WIRING DIAGRAM SUPPLIED WITH HOIST ONLY



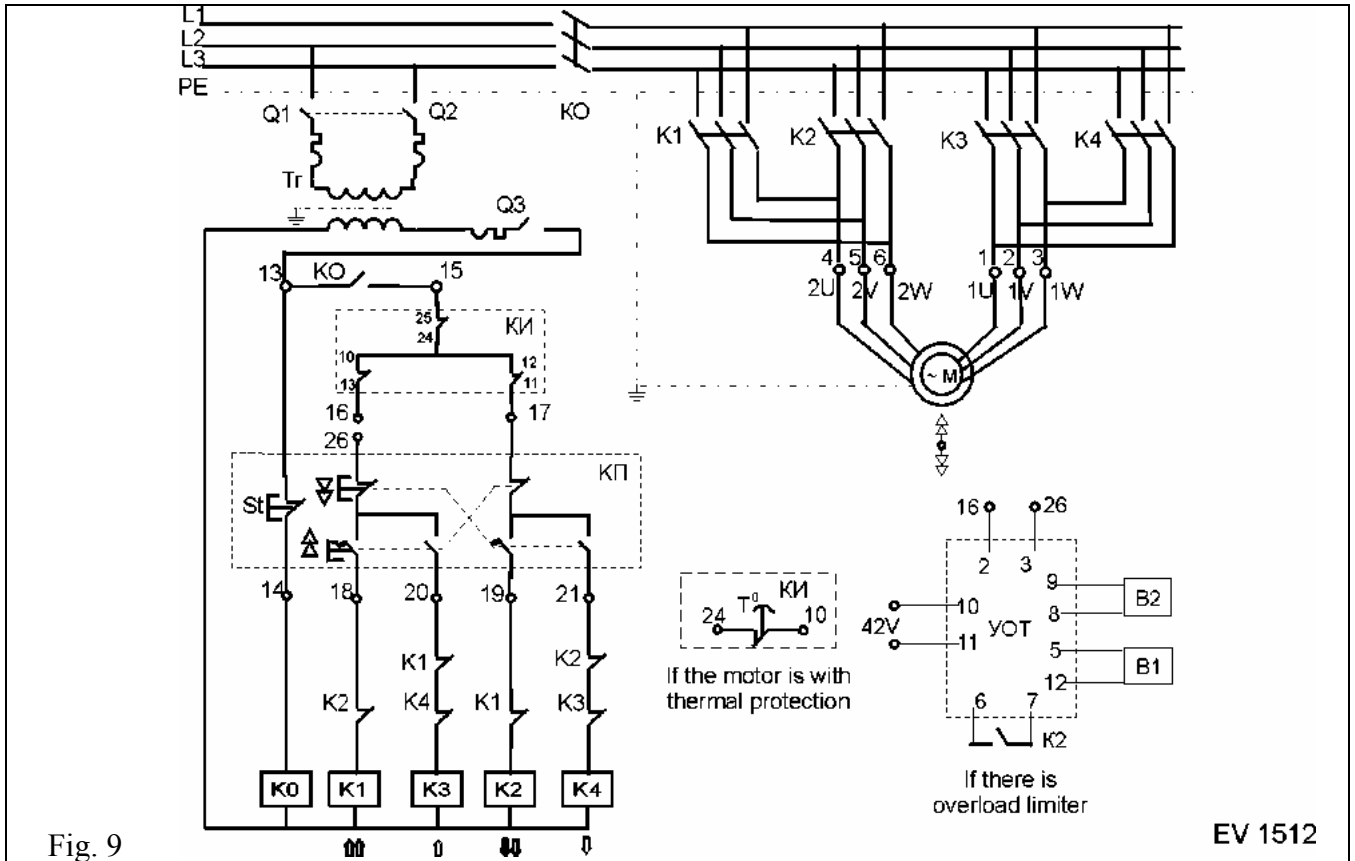
FACTORY USE ONLY - REFERENCE ELECTRICAL WIRING DIAGRAM SUPPLIED WITH HOIST ONLY

b) Principle electric scheme

Stationary electric hoist

Vertical movement with main and micro speed

FACTORY USE ONLY - REFERENCE ELECTRICAL WIRING DIAGRAM SUPPLIED WITH HOIST ONLY



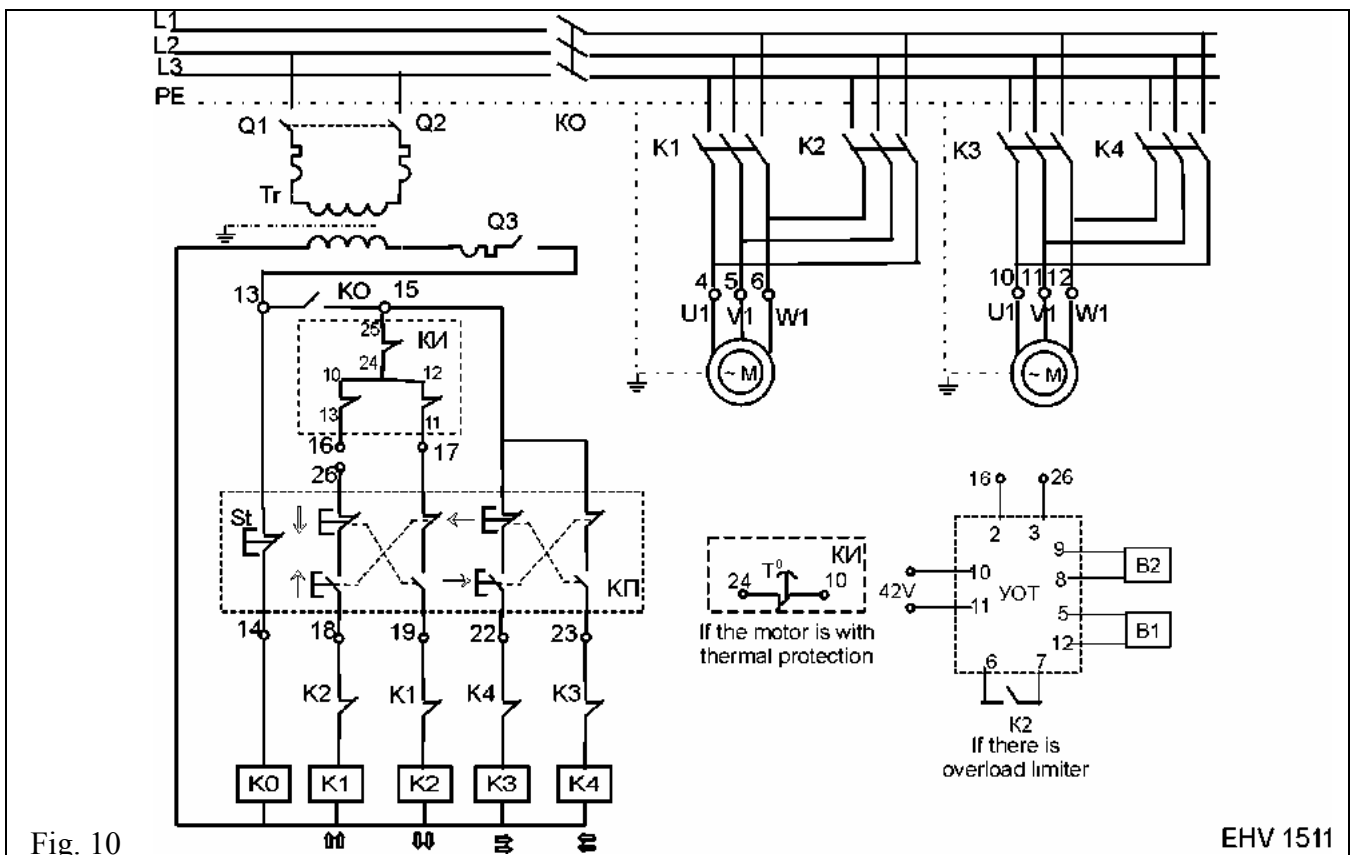
FACTORY USE ONLY - REFERENCE ELECTRICAL WIRING DIAGRAM SUPPLIED WITH HOIST ONLY

c) Principle electric scheme

Electric hoist with trolley

Vertical movement with main speed

Horizontal movement with main speed

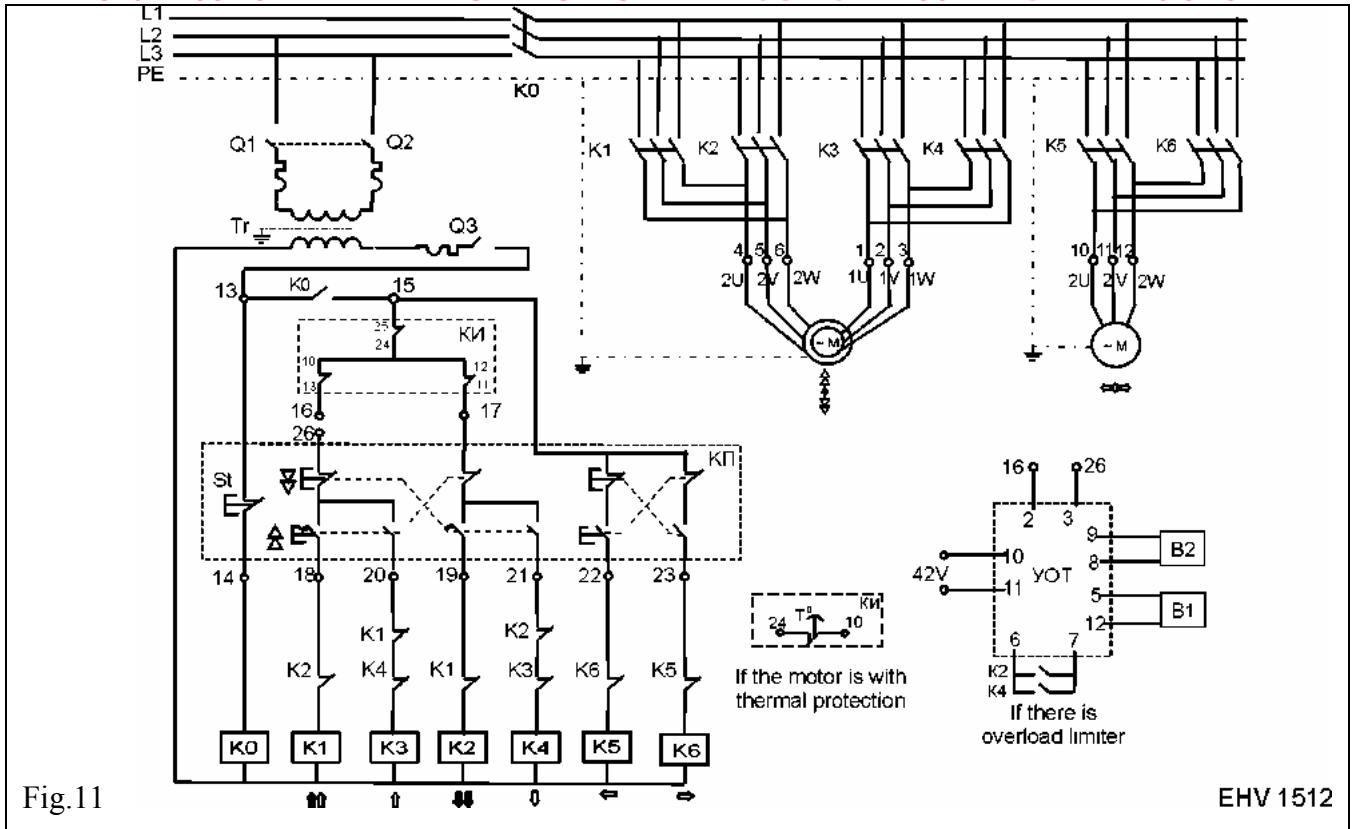


FACTORY USE ONLY - REFERENCE ELECTRICAL WIRING DIAGRAM SUPPLIED WITH HOIST ONLY

d) Principle electric scheme

Electric hoist with trolley
Vertical movement with main and micro speed
Horizontal movement with main speed

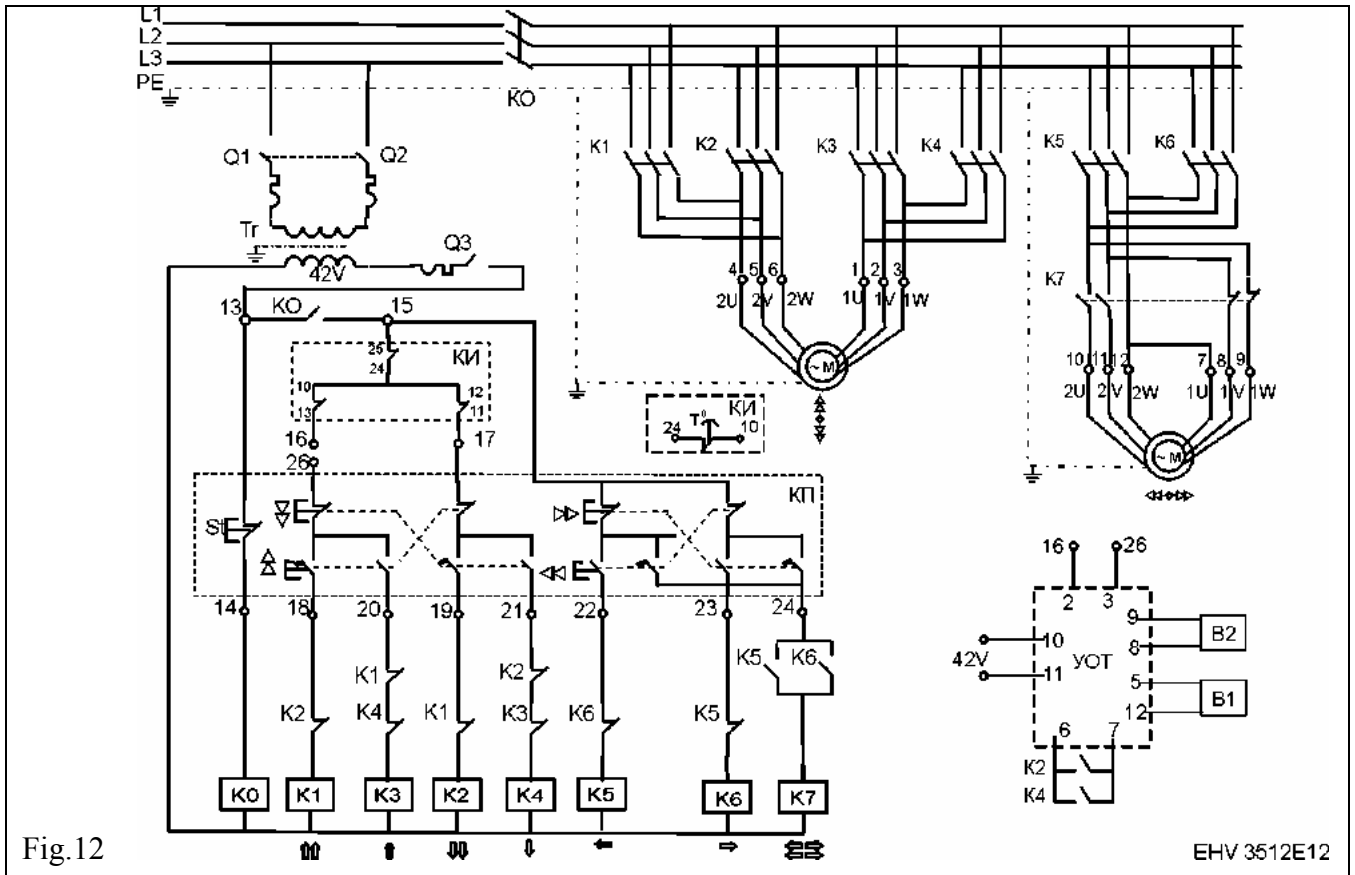
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FACTORY USE ONLY - REFERENCE ELECTRICAL WIRING DIAGRAM SUPPLIED WITH HOIST ONLY

e) Principle electric scheme

Electric hoist with trolley
Vertical movement with main and micro speed
Horizontal movement with main and micro speed



FACTORY USE ONLY - REFERENCE ELECTRICAL WIRING DIAGRAM SUPPLIED WITH HOIST ONLY

f) Principle electric scheme

Electric hoist with trolley

Vertical movement with main speed

Horizontal movement with main and micro speed

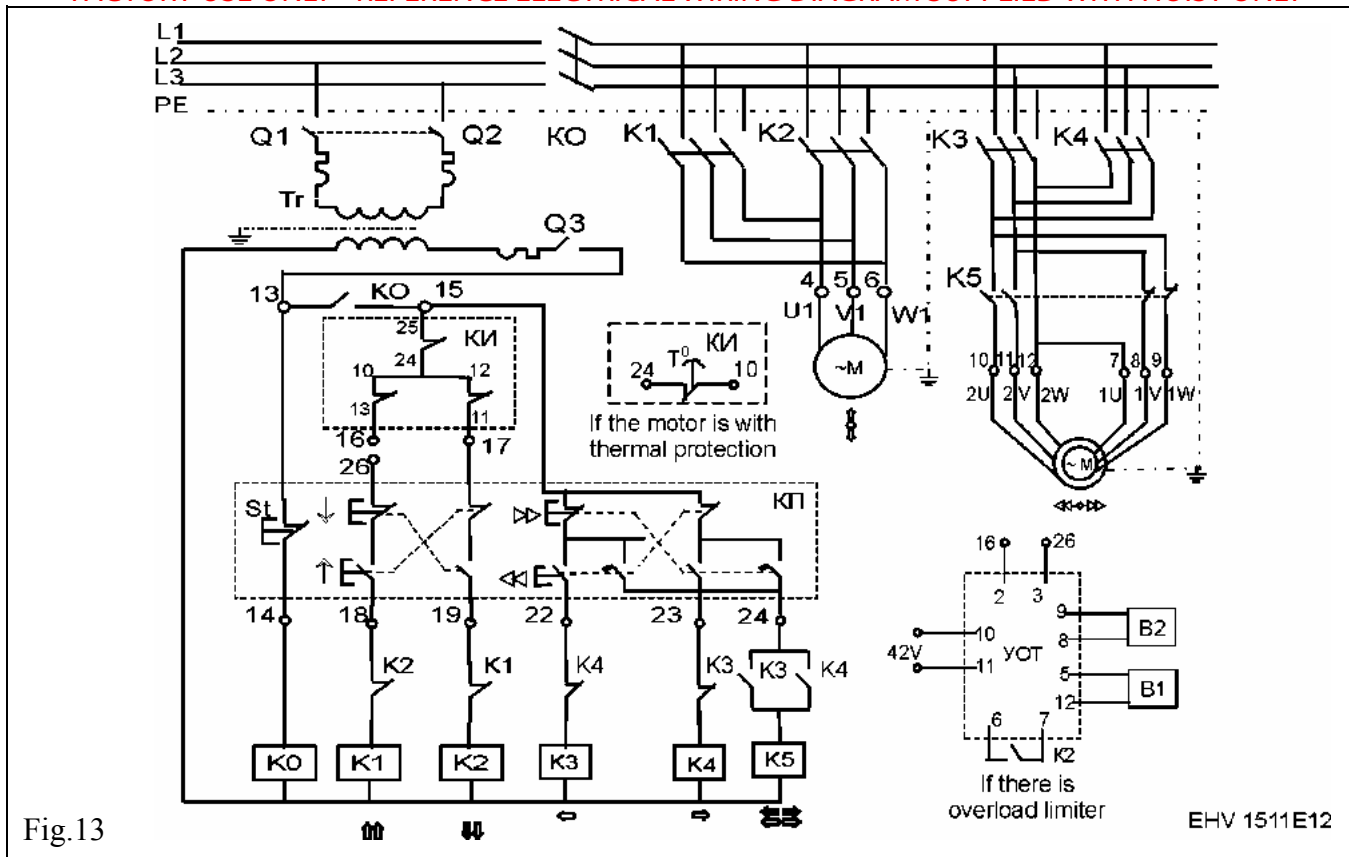
FACTORY USE ONLY - REFERENCE ELECTRICAL WIRING DIAGRAM SUPPLIED WITH HOIST ONLY

Fig.13

FACTORY USE ONLY - REFERENCE ELECTRICAL WIRING DIAGRAM SUPPLIED WITH HOIST ONLY

4.4. CHECKING THE CORRECT PHASE CONNECTION AND THE LIMIT SWITCH OPERATION

Checking the correct phase connection of the electric hoist should be done in the following cases:

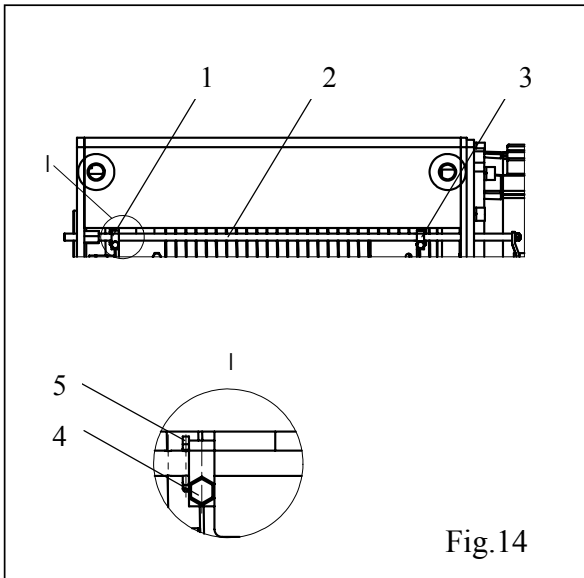
- before first start;
- after repair;
- after moving the hoist to other place.

The manufacturer checks the limit switch. Nevertheless, in the above cases the hoist operator should check the limit switch once again.

a) Checking the correct phase connection

The direction of hook movement depends on the sequence, in which the phases are connected.

Checking is performed, as follows: Push down the button for upward movement. (Fig. 1, Item 2). If the hook moves in opposite direction, two of the phase positions into the supply cable should be replaced.



b) Checking the limit switch operation

The limit switch, built into the hoist body, limits the hook end positions. This device limits the hoisting mechanism movement in both directions – at lifting and lowering the load. The end positions are determined by means of two limiting cramps 1 and 3 (Fig. 14) placed on the bar 2, which actuates the limit switch.

Checking is performed, as follows: The hook-block is stopped in the middle of lifting height. While pushing the button for upward movement, move by hand the limit switch bar 2 in the same direction of the rope guide movement, which corresponds to the hook movement direction. If the limit switch operates the hook-block stops.



The lever system of the limit switch is adjusted to work at the full lifting height. It is not allowed the limit switch to be adjusted for other intermediate hook positions e.g. the limit switch should not be used as operative.

If during exploitation limit switch adjustment is necessary then it is effected by changing position of the limiting cramps 1 and 3 placed on the bar 2 (Fig.14).

The distance between the floor and the lower end position of the hook-block is adjusted through limiting cramp 1, which is at the control panel side.

The distance between the electric hoist body and the upper end position of the hook-block is adjusted through limiting cramp 3, which is at the electric motor side.

After the limiting cramps are adjusted their screws 4 are tightened and additionally assured through split pins 5.

Adjustments check

Check of the upper end position of the hook-block

The unloaded hook is moved upwards until the limit switch is actuated. Thus the maximal braking path is realized.

Check of the lower end position of the hook-block

The loaded hook is moved downwards until the limit switch is actuated. Thus the maximal braking path is realized

The limit switch has a second emergency step. When the second step is actuated the distances are, as follows:

- The distance between the electric hoist body and the upper end position of the hook-block should be not less than 100 mm;

- The distance between the floor and the lower end position of the hook-block should be not less than 100 mm. In this position the drum should have at least three rope windings.

4.5. CHECKING THE HOIST LUBRICATION BEFORE STARTING ITS EXPLOITATION

All hoist parts and details are lubricated with enough quantities of oil and lubricants, which ensure its normal exploitation. The lubricant types, classification requirements and quantities applied are given in p. 5.12.

Before starting operation it is necessary to check and lubricate all places indicated in the lubrication scheme - Table 13.

4.6. FIXING THE WIRE ROPE ENDS



Fixing the wire rope ends is of prime importance for the electric hoist safe operation.

In some cases, depending on the hoist size and its packing, the hook-block could be supplied dismantled from the wire rope. The following requirements should be kept during mounting the rope to the hook:

- the wire rope should be stretched tightly and not twisted; the corresponding reeving scheme from Fig. 17 should be used;
- the wire rope fixing to the body and to the drum should be done in accordance with the schemes shown on Fig. 15 and Fig. 16.

a) Fixing the rope ends to the body

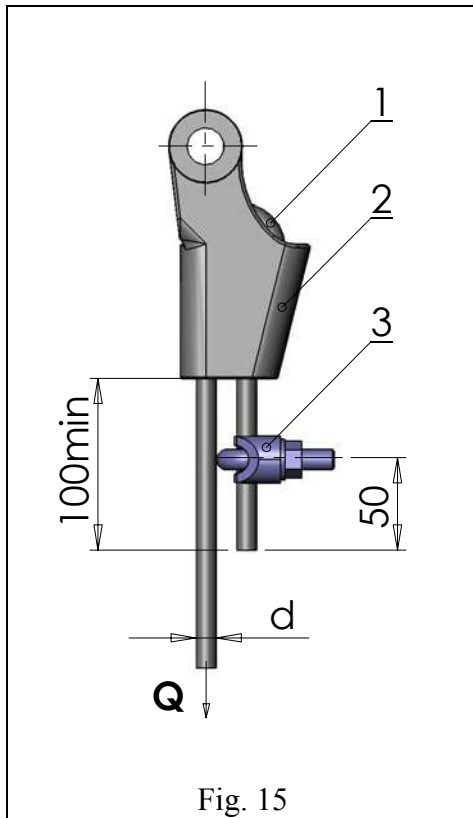


Fig. 15

The rope with diameter “d” is put in cotter bush 2 (Fig. 15) in such way, that the carrying rope branch lay on the vertical side of cotter 1. Conforming to DIN 15020, part 1, p. 6.4, in order to protect the rope end against pulling out, an assurance cramp 3 is mounted as per DIN 1142. The cramp is tightened through two ring nuts type SC according to DIN 1142. The screws tightening torques are in accordance with DIN 1142, (see Table 4).

The rated cramp size given in Table 4 is equal to the maximal rated diameter of the wire rope.

The distances indicated on Fig. 15 should be kept at rope mounting, i.e.:

- The distance between the rope end and the cotter bush 2 (Fig. 15) should be minimum 100 mm. The maximal distances are:
 - 250 mm for hoist capacities 0.5 and 1 t;
 - 350 mm for hoist capacities from 2 to 5 t;
 - 450 mm for hoist capacities from 8 to 20 t.
- The distance between the cramp 3 and the rope end should be 50 mm.

Table 4

Cramp Rated Size	Ring Nut Size, Type SC	Tightening Torque, Nm
5	M5	2.0
6.5	M6	3.5
8	M8	6.0
10	M8	9.0
13	M12	33
16	M14	49
19	M14	67.7
22	M16	107
26	M20	147
30	M20	212
34	M22	296
40	M24	363

b) Fixing the rope ends to the drum

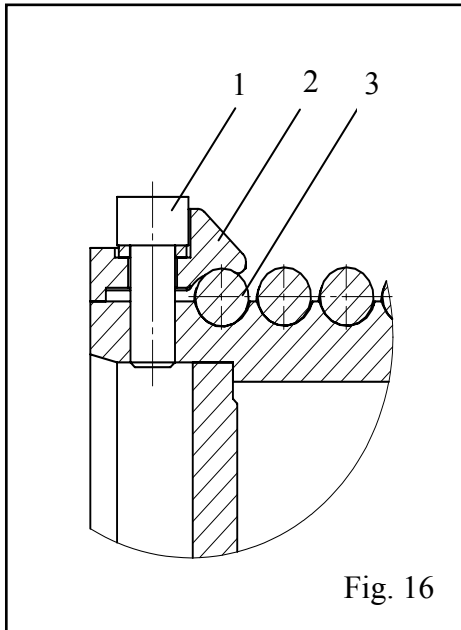


Fig. 16

Fixing the rope end 3 to the drum (Fig. 16) is done by means of pressing cramps 2, each on screwed up with two screws 1. The screw dimensions and their strength class are given in Table 7.

The screw tightening torques are pointed out in Table 19.

Table 5

Load in Rope Branch, kg	Screw Size, mm	Strength Class
500	M 6	8.8
1000	M 10	8.8
1600	M 10	8.8
2500	M 12	8.8
4000	M 16	8.8

c) Mounting the rope through the hook and the reeving rolls

At mounting the rope through the hook and the reeving rolls attention should be paid not to twist the wire rope.

After closing the cotter the hook-block should not hang twisted and the wire rope should not be tangled.

Fig. 17 shows how to mount the rope through the hook and the reeving rolls depending on the reeving type.

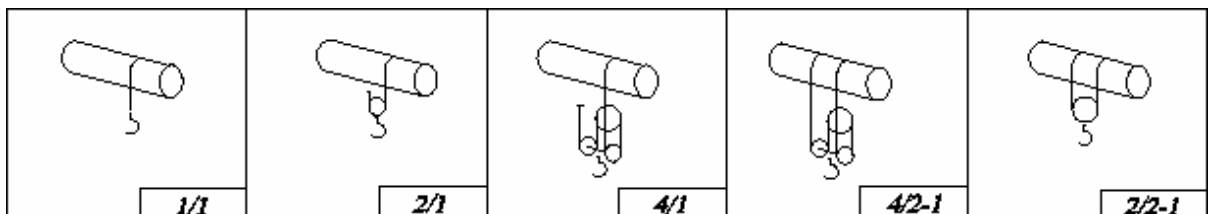


Fig. 17

4.7. MOUNTING OF STATIONARY ELECTRIC HOIST

The following ways of stationary mounting of electric hoist to a plane are possible:

- upon horizontal plane (standing) - Fig. 18, type A;
- under horizontal plane (hanging) - Fig. 18, type B;

On client's request, the stationary electric hoists could be mounted on a vertical plane (wall) - Fig. 18, types C and D.

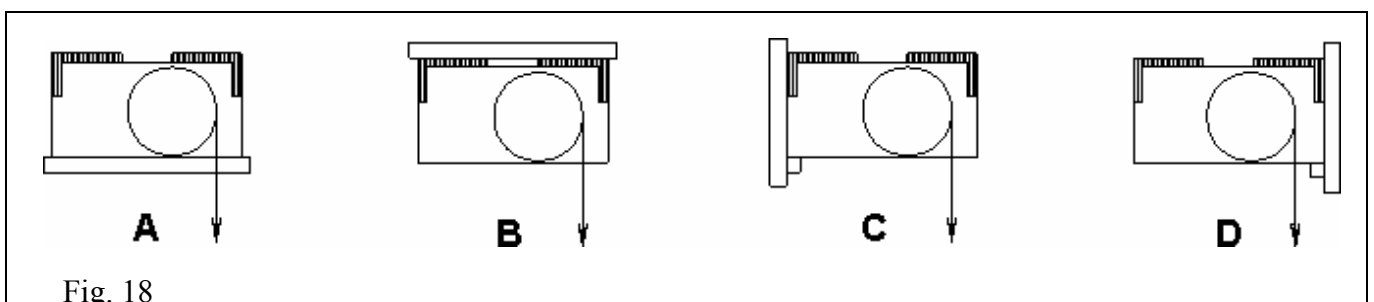
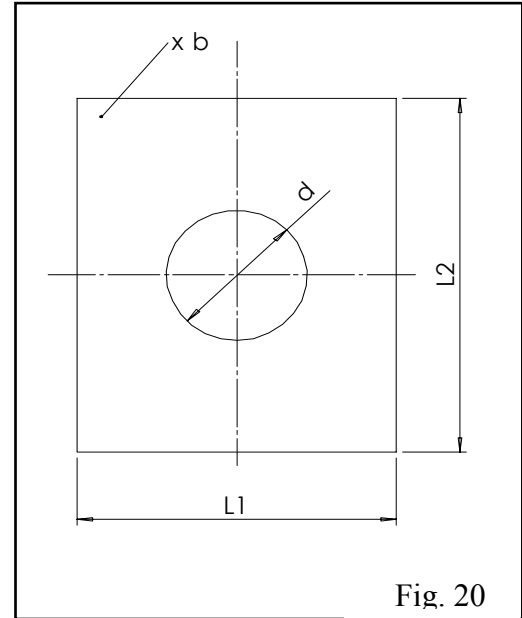
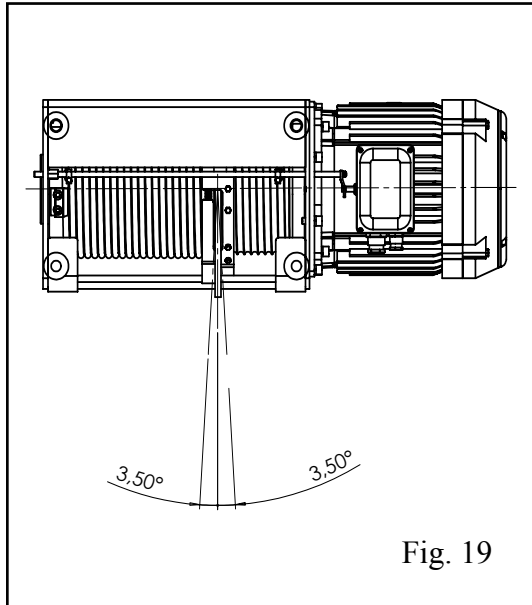


Fig. 18

The rope lateral deviation in relation to the axis of the drum channels influence on the wearing out of the rope wires and the rope guide. That is why the deviation should be maintained minimal. The hoist should be mount in such position that the maximal lateral deviation of wire rope not to exceed 3.5° (Fig. 19). This could be achieved by adjusting the level of plane, on which the hoist is mounted.



NOTE: Before mounting the hoist onto or under a horizontal plane, under the hoist foots and onto the hoist body several plates (Fig. 20) with dimensions in accordance with Table 6 should be put under.

Table 6

Mounting Type (see Fig.18)	Capacity [t]	Reeving	b	d	L1	L2
			[mm]	[mm]	[mm]	[mm]
A	5	2 x 1	15	Ø26	50	50
	10	4 x 1	15	Ø26	50	50
B	3,2	2 x 1	20	Ø22	50	60
	6,3	4 x 1	20	Ø22	50	60
	5	2 x 1	20	Ø26	50	50
	10	4 x 1	20	Ø26	50	50

4.8. MONORAIL PATH CONSTRUCTION AND MOUNTING THE TRAVELLING MECHANISM ON IT

The monorail path should be built up only by standard profiles.

The monorail path should be mounted on a suitable construction, which is able to carry out the corresponding load. The rails should be fixed in proper way ensuring safe movement of the electric hoist on them.

Only authorized persons should design and mount the monorail path in accordance with the corresponding state standards.

The electric hoists with travelling mechanism (trolley) are designed to operate by use of standard profiles as per DIN 1025:

- hot-rolled I-profiles, in accordance with DIN 1025 BI.1 with numbers from I-200 to I-600, (profile width $b = 90$ to 215). These profiles have belt inclination.
- hot-rolled I-profiles, execution IPE, in accordance with DIN 1025 BI.5 with numbers from IPE-180 to IPE-600 (profile width $b = 91$ to 220). These profiles are with zero inclination of the profile belt.
- hot-rolled I-profiles, execution IPB, in accordance with DIN 1025 BI.2 with numbers from IPB-100 to IPB-1000 (profile width $b = 100$ to 300). These profiles are with zero inclination of the profile belt.

When bending a profile, please take into consideration:

- make clean bending curves (with constant radius):
- in the bended profile sections do not allow deformations out of the standard limits pointed out in DIN 1025.

The particular profile number, the corresponding maximal allowed inclination of the rail path and the minimal bending radius are indicated in each hoist Passport.



It is not allowed:

- a) to use profiles with dimensions less than indicated in the Passport;
- b) the rail path to have curved sections with radius less than indicated in the hoist Passport.

During exploitation of the rail path, please keep the following rules:

- Do not allow dirt onto the monorail path or obstacles before the travelling mechanism (devices hanging from girders, connecting plates, bolt heads and so.)
- Do not paint the surfaces, on which the wheels travel, because it disturbs the good cohesion between the wheels and the rail path.
- In order to avoid wheel slipping do allow oil, grease, ice and other dirt onto the rail and regularly clean the rail path.
- Regularly check the rail path for cracks and wearing out. If such are found, take measures in accordance with the corresponding state norms.

In order to avoid dangerous deformations, which could occur when the travelling mechanism reaches the rail ends, it is recommended to put rubber buffers in the rail ends (VBG9, § 19).

4.8.1. Travelling mechanism mounting

Firm trolley

The trolley construction is convenient and easy to mount, dismount and operate. It is designed for monorail paths with different profile sizes.

The travelling mechanism could be mounted in two modes:

A. Mounting of travelling mechanism with accessible monorail path end:

- remove the monorail path ends;
- mount the travelling mechanism on the monorail path end;
- put back the monorail path ends;

This mounting mode is equal for all constructions.

B. Mounting of travelling mechanism with inaccessible monorail path end:

- dismantle the elements determining the distance between the supporting and driving wheel;
- increase the distance between both wheels;
- mount the travelling mechanism to the monorail path from below;
- fix the elements determining the distance between the supporting and driving wheel.

This mounting mode depends on the travelling mechanism construction.

After final mounting of the travelling mechanism on the monorail path, the following checks should be done:



- *The elements determining the distance between the supporting and driving wheel should be fixed firmly and ensured against unscrewing;*
- *It is obligatory to ensure distance of 0.5 ... 4 mm between the wheel and the rail belt. It is of great importance for the normal trolley operation.*

The travelling mechanism is adjusted for standard profile with determined profile width b , but it is possible to be adjusted for other widths b .

The travelling mechanism adjusting for different profile widths and its mounting in B mode depend on its construction. The variants are:

a) Travelling mechanism of low headroom electric hoist

The mounting scheme is shown on Fig. 21:

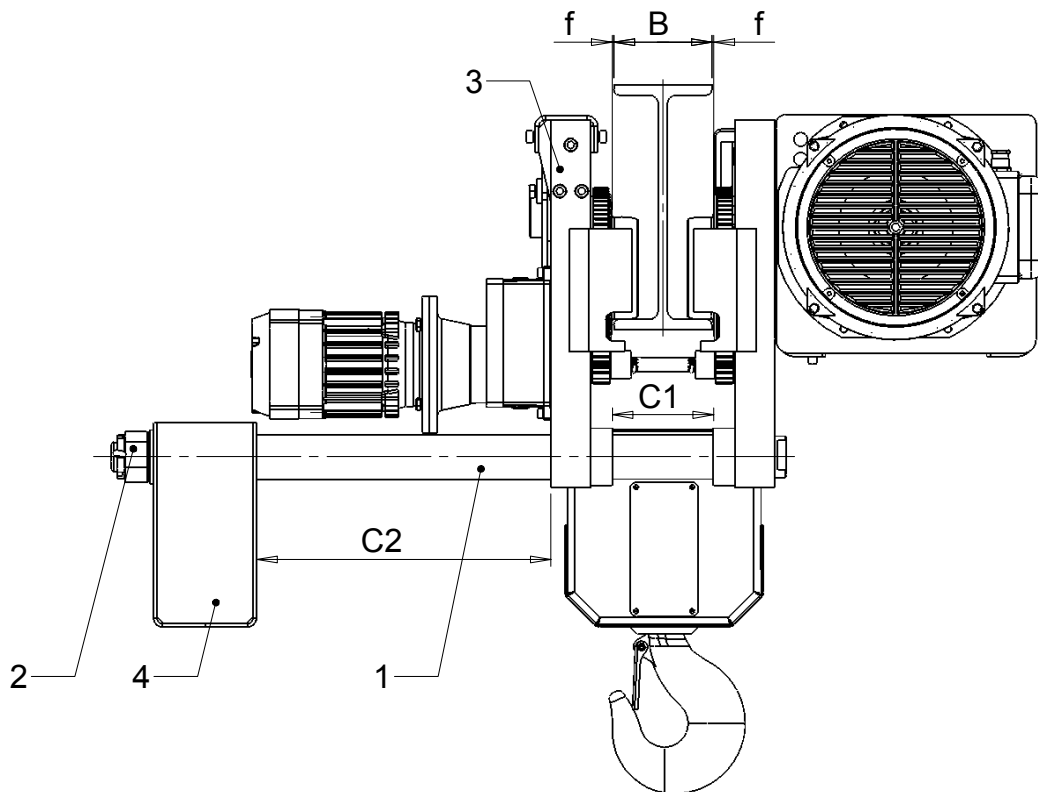


Fig. 21

The mounting mode type B is, as follows (Fig. 21):

- remove the split pins from both pins 1, which ensure crown ring nuts 2 and unscrew the nuts;
- increase the distance C1 between the travelling wheels 3;
- mount the travelling mechanism from below;
- screw up the crown ring nuts 2 with torque taken from Table 19 (ring nut strength class 5) and fix them with the split pins.

Low headroom trolley adjustment for other rail widths b

Decrease the distance C1 by transferring washers to the set of washers determining the distance C2 (or vice versa). the following equation should be kept

$$C1 + C2 = const.$$

The washer set length C1, necessary for mounting a monorail path with width b , is determined by the formula:

$$C1 = b \begin{matrix} +7,0 \\ +1,0 \end{matrix} \text{ [mm]}$$

After final mounting of the travelling mechanism on the monorail path there should be a distance of $f = 0.5 \dots 4$ mm between the travelling wheel and the rail belt.

Balancing of low headroom electric hoists

After the low headroom hoist is mounted on the monorail path, it is necessary to be balanced. Balancing is achieved by means of counter-load 4. The counter-load box should be filled in with balancing material (metal scrap) and poured on with concrete layer about 2 cm thick.

b) Travelling mechanism type “T” for normal headroom electric hoist (Fig. 22)

- remove the split pins from both pins 1, which ensure the ring nuts 2 and unscrew the nuts;
- increase the distance between the driving block 3 and supporting block 4;
- mount the travelling mechanism from below;
- screw up the crown ring nuts 2 with torque taken from Table 19 (ring nut strength class 5) and fix them with the split pins

After final mounting of the travelling mechanism on the monorail path there should be a distance of $0.5 \dots 4$ mm between the travelling wheel and the rail belt.

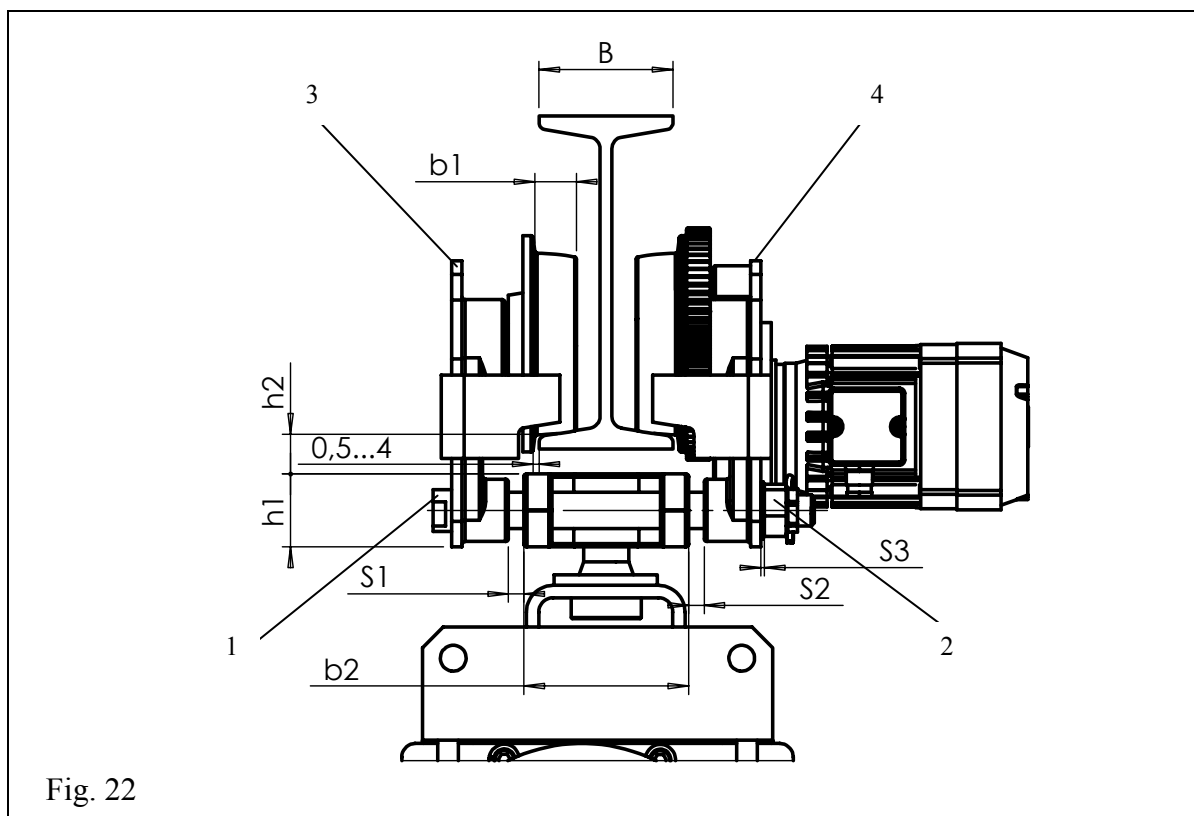
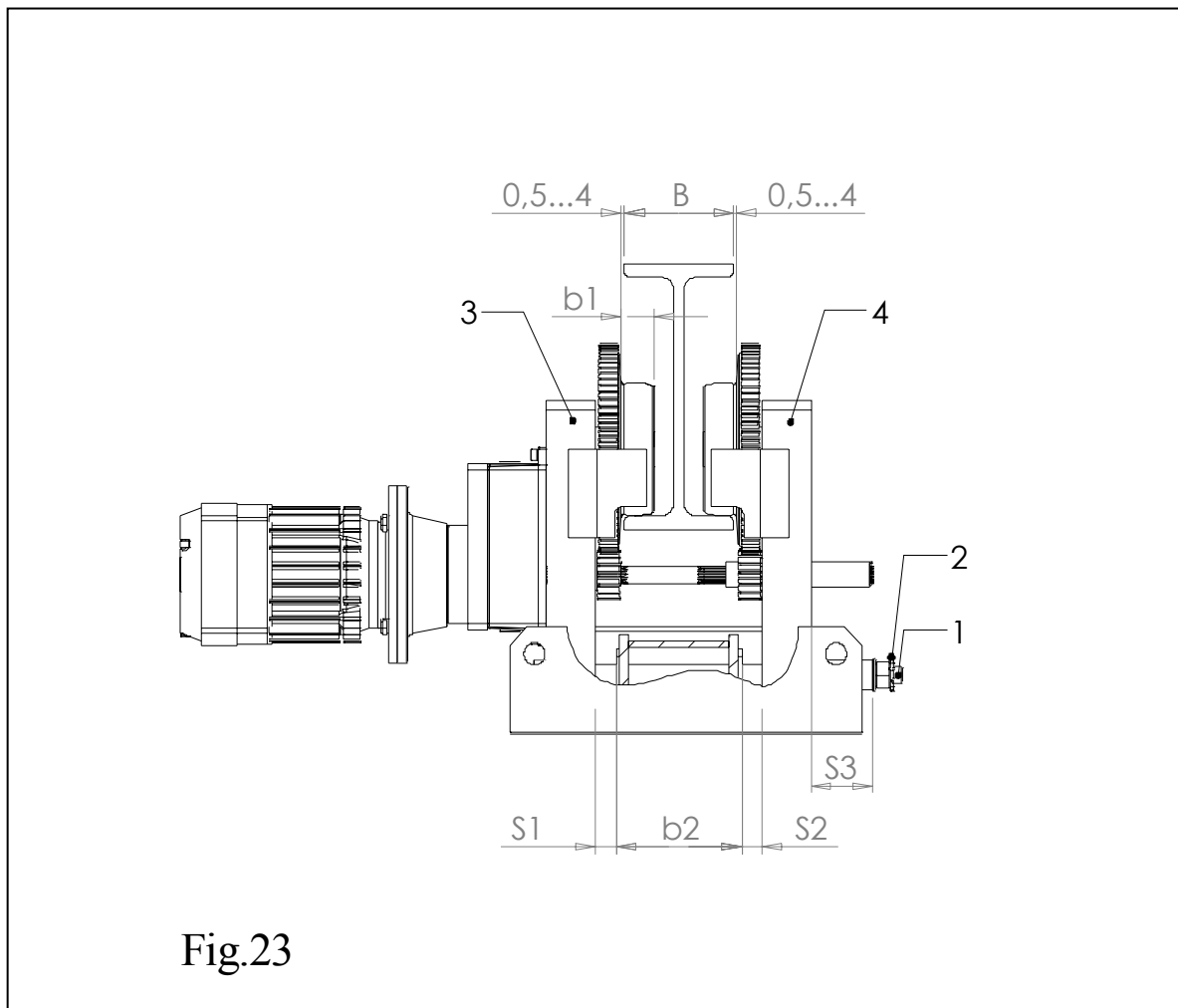


Fig. 22

b) Travelling mechanism type “XM” for normal headroom electric hoist (Fig. 23)

- remove the split pins from both pins 1, which ensure the ring nuts 2 and unscrew the nuts;
- increase the distance between the driving block 3 and supporting block 4;
- mount the travelling mechanism from below;
- screw up the crown ring nuts 2 with torque taken from Table 19 (ring nut strength class 5) and fix them with the split pins

After final mounting of the travelling mechanism on the monorail path there should be a distance of 0.5 ... 4 mm between the travelling wheel and the rail belt.



Adjustment of trolley types T and XM for other rail widths b

The travelling mechanism could to be adjusted for other rail widths b .

It is effected by transferring between the sets of washers determining the distances $S1$, $S2$ and $S3$. The following equation should be kept

$$S1 + S2 + S3 = \text{const.}$$

All washers are 2.5 mm thick. The number of washers determining the distances $S1$, $S2$ and $S3$, is pointed out in Table 8.

Table 8

Capacity, kg	Dimensions at Fig. 22	Profile as per GOST19425-74				Profile as per DIN 1025 BI.1									
		Designation				Designation									
		18M	24M	30M; 36M	45M	200	220	240	260	280	300	320	340	360	380
		Profile width b				Profile width b									
		90	110	130	150	90	98	106	113	119	125	131	137	143	149
Number of washers in set (washer thickness 2.5 mm)															
1000	S1	2	6	10	-	2	4	5	7	8	9	10	-	-	-
	S2	2	6	10	-	2	4	5	7	8	9	10	-	-	-
	S3	16	8	-	-	16	12	10	3	4	2	-	-	-	-
2000 and 3000	S1	-	-	3	7	-	-	-	-	-	-	3	4	5	7
	S2	-	-	3	7	-	-	-	-	-	-	3	5	6	7
	S3	-	-	8	-	-	-	-	-	-	-	8	5	3	-
5000	S1	-	-	3	7	-	-	-	-	-	-	3	4	5	7
	S2	-	-	3	7	-	-	-	-	-	-	3	5	6	7
	S3	-	-	8	-	-	-	-	-	-	-	8	5	3	-

4.9. FIRST START AND SERVICING

Before starting hoist operation the following control actions should be performed:

- check of correct hoist fixing;
- check of limit switch at the upper and lower hook end positions (the hoist should be unloaded);
- buffers availability and their reliable work;
- if hook movement direction corresponds to the pendant station buttons;
- check of all safety devices operation (limit switch, brakes, etc.);
- if all electrical devices operate properly.

Before first start and also after each material changes, the electric hoist should be tested by an expert authorized by the corresponding state authorities [VBG8 §23 (1) and VBG9 §25]. The user ensures the necessary managing, servicing and maintenance specialists (as per p. 5 of DIN 15030).

At least once a year a periodical testing should be performed by a competent body [VBG9 §26(1) and VBG8 §23(2)]. According to VBG9 §27, the user should fill the testing results in the electric hoist Diary.

The Diary could be created using a model recommended by the corresponding state norms. Attachments to the Diary: copies of electric hoist Passport block hook certificate, wire rope certificate.

If there is not a diary model in the corresponding normative documents, the following structure could be used:

1. Front page named 'Electric Hoist Diary' containing: hoist serial number, manufacturer's company, user's company, inventory number.
2. Copies of hoist Passport, block hook and wire rope certificates are attached.
3. Results of tests performed before starting exploitation or after repair:

Test Type	Corresponding Norm	Result		Note	Expert Signature	Date
		Yes	No			
Preliminary						
At Mounting						
At Accepting						

4. Results of periodical annual tests. The periodical tests are carried out in accordance with:

Test Type	Result	Authorized Expert Name and Company	Authorized Expert Signature	Date
Periodical	Defects not registered (Defects registered, Report No...)			
Periodical	Defects not registered (Defects registered, Report No...)			

4.9.1. Electric hoist servicing

The electric hoist operator should acquaint himself with the current Instruction and should be instructed for the Safety requirements.

The operator should have suitable cloths according to working conditions.

The requirements for safe operation of the corresponding state norms should be kept during hoist exploitation. The operator should have constant access to the present Instruction or copy of the Safety requirements. They could be placed near the mains switch or at easy accessible place.

Table 9 contains requirements towards the hoist operator and the servicing personnel in accordance with VBG8 and VBG9. According to VBG9, §2 electric hoists with travelling mechanism are considered for cranes.

The term ‘Electric hoist operator’ to be identified with the term ‘Crane operator’.

Table 9

Requirements	Source	Source Extracts
Requirements towards the hoist operator and the servicing personnel	VBG8 §24	(1) Only competent and well informed people should perform mounting, technical maintenance and servicing of mechanisms.
Daily checks of brake and limit switch	VBG9 §30	(1) Crane operator should check the brake and the emergency steps of limit switch daily before starting work. He should monitor the crane condition for obvious damages. (2) At registering damages, which jeopardize safe exploitation, the crane operator should stop operation immediately.
To protect the hoist operating under shelter against wind	VBG9 §30	(6) The crane operator should take care to stabilize the crane during storms and to mount wind protection appliances.
Never move loads overhead people	VBG9 §30	(9) By using load catching devices, which operate through magnets, suckers or friction force, the load should not be moved overhead people without installing additional protection appliances.
To protect people, which hang the load on	VBG9 §30	(10) Loads hung by hand should be moved only after giving sign from the hanging person to the signal post or other responsible person, determined by the owner.

Table 9 - Continuation

Requirements	Source	Source Extracts
The hoist operator should always follow the hanging load	VBG9 §30	(11) The crane operator should hold the pendant station until there is load on the crane.
The emergency limit switch should not be used for other purposes	VBG9 §30	(13) The emergency limit switch should not be used as operative.
The switching device should be checked daily for apparent defects or malfunctions	VBG8 §27	Before starting work the operator should check the limit switch functions. He must observe the mechanisms, including their carrying appliances, rolls, equipment and carrying constructions for apparent defects.
Do not overload the electric hoist	VBG9 §31	(2) The cranes should not be loaded over the permissible load for a certain moment.
Operation in common with other hoisting equipment	VBG9 §33	(1) If the working zone is crossed by more than one crane, the owner or a person authorized by him should determine a working schedule and to take care for the mutual understanding between the crane operators.
Do not transport people	VBG9 §36	(1) It is forbidden to transport people with the load or with the hoisting and handling equipment.
Do not drag or pull oblique loads	VBG9 §37	(1) It is forbidden to drag or pull oblique loads, as well as pulling vehicles with load.
Do not tear firmly connected loads	VBG9 §38	(1) The owner could use the crane for tearing connected loads only if there is overload limiter mounted on the crane.
Avoid impulse switches to prevent the commutation apparatuses.		
Do not operate the electric hoist near electric appliances, which are under tension	VBG9 §39	(1) If the crane operates near exploitation parts and electric appliances under tension, the owner should prevent people from touching them. (2) The crane operator should pay attention during operation not to be endangered by exploitation parts and electric appliances under tension.
Hoisting inflammable liquids	VBG8 §15	All mechanisms intended for hoisting inflammable liquids should have two independent brakes.
Handling loads, which could get stuck at their path	VBG8 §33	(5) Loads, which could get stuck, pressed hold or hung at their path, should be handled only by mechanisms equipped with overload limiter.

5. OPERATION AND MAINTENANCE

General requirements

- All maintenance and repair works should be done at unloaded hoist.
- Remove the auxiliary devices for load gripping
- Annual check should be performed according to the requirements of VBG 8 §23 (2), VBG9 § 26 (1), respectively.

Besides above mentioned requirements, the following should be taken into consideration:

Requirements towards checks and maintenance	Extracts from VBG 9
The mains switch to be off and ensured against incompetent switching on by means of a warning label	§41.(1). All maintenance and inspection works should be done only if the crane is surely switched off and ensured against incompetent switching.
The mains switch could be on only the nature of work requires the hoist to be switched on (wire rope lubrication, functional tests of electric elements and s.o.)	§41. (2). The above requirement could be avoided only if the maintenance and inspection works require the crane to be switched on and there is no danger of : 1. contusion or falling down; 2. touching parts, electric appliances and exploitation devices under tension; 3. lack of connection with the crane operator.
A working platform (or other similar device) should be always in disposal during electric hoist servicing and maintenance	§10. If maintenance and repair works could not be performed from the floor, a special working place or platform should be installed. The workers should reach the platforms safely and do the necessary works without hazard.
Starting hoist operation after repair; works within the electric hoist operation zone	§43. After repairs, adjustments or works within the electric crane operation zone, the crane operation should be started only after permission given by the owner or his representative. They should make sure that: 1. all works are finished; 2. the whole crane condition allows safe exploitation; 3. all workers are left the crane.

5.1. MAINTENANCE

Regular and correct servicing and maintenance guarantee the electric hoist smooth operation. The hoists should not be exploited at loading regime harder than prescribed by the manufacturer.

The hoist maintenance includes checks of the technical condition and adjustment, finding failures and their removal, technical servicing (lubrication and s.o.), periodical maintenance works.

5.1.1. Periodical checks

Periodical checks are of prime importance for ensuring a flawless hoist operation.

The check types and their periods are given in Table 16. All check points (taken from the description of hoist units and details) are also indicated.

5.1.2. Lubrication, regulation and adjustment

The lubrication scheme and the lubrication points are given in Table 13. The necessary lubrication materials are indicated in Table 14.

The periods for adjustment and regulation are pointed out in Table 10 as well as their description. The periodicity of these works depends on the production conditions. Regular cleaning the dust and dirt is of prime importance.

If electric hoist is stored more than 3 months after purchase date, all checks at first start should be effected in accordance with the Maintenance plan (Table 10).

5.1.3. Repairs and reconstruction works

Such works are removal of small failures, detected during checks i.e.:

- cable defects and their removal;
- changing relays and contactors.

Here do not belong complicate and responsible works, which should be co-ordinated with the manufacturer, such are:

- changing the principle electric scheme;
- connecting additional devices and apparatuses.

Works under tension are allowed only on necessity und keeping the safety requirements prescribed by the corresponding norms.

Possible failures in the electric appliances and some ways for their removal are indicated in Table 15.

5.1.4. Maintenance plan

Table 10 contains the maintenance schedule. It is developed for operation in normal environment condition and according the hoist operation group as per FEM 9.511. If the hoist operates in harder regime, these terms should be shortened.

Table 10

No	At first start	Daily at the beginning of working day	After first 3 months	After first 12 months	Further after every 12 months	Type of check and servicing
1	■	■				Brake operation – if the load flows or the braking path is increased, it is necessary to adjust the axial rotor run (see p. 5.4)
2	■	■				Limit switch operation (p. 4.4) and emergency stop button
3	■	■				Visual examination of: - pendant station and its cable(p. 5.11a); - block hook (p. 5.7)
4		■				Rope – check for damaged or broken wires (p. 5.2)
5			■		■	Fixing the wire rope (p. 4.6) and rope guide operation (p. 5.3)
6			■		■	Roller block and hook detail (p. 5.7)
7			■		■	Carrying screw joints (p. 5.10)
8			■		■	Welded joints
9			■		■	Buffer condition – replacement if necessary
10				■		Travelling wheels and swinging joints of the trolley incl. the distance between the guiding wheel rollers and the monorail path (p. 5.6)
11			■		■	General condition of the electric appliances (p. 5.11)
12				■		Control of the corrosion protection and its improvement if necessary

5.1.5. Periods of checks repetition

- The electric hoist should be checked at least annually from experts. The experts could be specialists from the Technical surveillance commission or authorized ones.
- Only original spare parts produced by the manufacturer should be used in repair.

5.2. CHECK OF WIRE ROPE WEARING OUT. DISCARD AND REPLACEMENT

Wire rope maintenance consists of its regular lubrication (Table 13) and check of its wearing out (p. 5.2.1).

Rope lubrication decreases friction between the rope and the drum channels as well as between the separate wires within the rope. Thus the wire rope life is increased and the corrosion is reduced. The lubricant should be of moderate quantity and spread uniformly alongside the whole wire rope length.

If there is increased contamination the wire rope should be cleaned regularly.

5.2.1. Check of rope wearing out and discard

The rope should be checked periodically for wearing out in accordance with Table 10. The wire rope discard is performed conforming to the requirements of ISO 4309 and DIN 15020 BI.2.

The rope condition is estimated using the following criteria (DIN15020BI.2):

a) Type and number of broken wires

Te check for broken wires is done at unloaded rope, which is held by hand in operational position. Thus the broken wires are easy to notice.

Wire rope discard is done according to the broken wires alongside definite rope length as per DIN 15020 BI.2 and ISO 4309 (see Table 11).

Table 11

Number of carrying wires in the outer rope sneafs, n	Examples f or wire rope construction	Number of visible broken wires causing discard							
		Group FEM 9.511: 1Am, 1Bm, 1Cm, 1Dm				Group FEM 9.511: 2m, 3m, 4m, 5m			
		cross curve		unilateral curve		cross curve		unilateral curve	
		alongside rope section with length $6d$ and $30d$, where d is the rope diameter							
		$6d$	$30d$	$6d$	$30d$	$6d$	$30d$	$6d$	$30d$
up to 50		2	4	1	2	4	8	2	4
51 to 75		3	6	2	3	6	12	3	6
76 to 100	18x7(1+6)	4	8	2	4	8	16	4	8
101 to 120	6x19(1+6+12) 6x19(1+6+6F+12) 36x7(1+6)	5	10	2	5	10	19	5	10
121 to 140		6	11	3	6	11	22	6	11
141 to 160	8x19(1+6+6F+12)	6	13	3	6	13	26	6	13
161 to 180	6x36[1+7+(7+7)+14] 8x19(1+6+6(6)+1.O.C	7	14	4	7	14	29	7	14
181 to 200		8	16	4	8	16	32	8	16
201 to 220		9	18	4	9	18	35	9	18
221 to 240	6x37(1+6+12+18)	10	19	5	10	19	38	10	19
241 to 260		10	21	5	10	21	42	10	21
261 to 280		11	22	6	11	22	45	11	22
281 to 300		12	24	6	12	24	48	12	24
over 300		0,04.n	0,08.n	0,02.n	0,04.n	0,08.n	0,16.n	0,04.n	0,08.n

b) Broken wires position

If there is a broken sneaf, the wire rope should be discarded immediately.

c) Decreasing the rope diameter during exploitation

Even if there are no broken wires, the rope should be discarded if a long rope section decreases its diameter under the prescribed limits in ISO 4309 and DIN 15020 BI.2.

d) Corrosion

Corrosion of the outer rope parts could be registered visually.

e) Change in the wire rope shape

This check should be carried out by a specialist. Different types of rope deformation are indicated in ISO 4309 and DIN 15020 BI.2.

Some typical wire rope changes leading to discard are:

- 'basket' deformation;
- local increasing in the rope diameter;
- local decreasing in the rope diameter;
- separating the rope wires in one sneaf and their bending outside;
- thermal or electrical damages;
- the rope core goes outside;
- plastic deformations.

5.2.2. Wire rope replacement

The old wire rope is removed and the new one is mounted, as follows:

5.2.2.1. Removing old wire rope

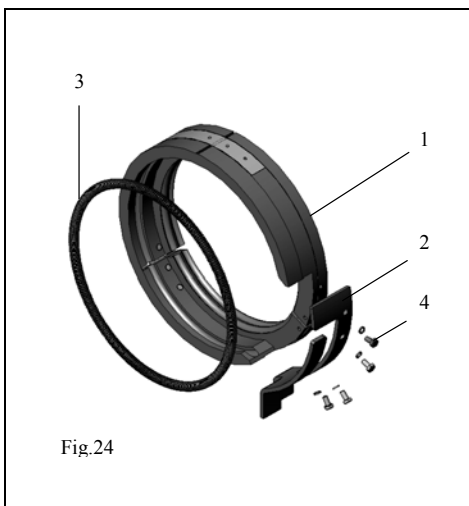


Fig.24

The old wire rope is removed in the following sequence:

- lower the hook block until it lay down on a hard fulcrum. The limit switch for the lower end position should not be actuated;
- unscrew the screws 4 and release the guide 2 from the guiding ring nut 1 (Fig. 24). Unstrap the screw spring 3, which presses the wire rope and remove it together with the guiding nut;
- switch on the electric hoist for downward movement and unwind the remaining rope windings from the drum. Release the rope end from the drum. Knock out the cotter with hummer and release the other rope end from the cotter bush.

5.2.2.2. Mounting new wire rope

- clean up the drum channels and lubricate them with the prescribed lubricant (see Table 14);
- prepare a new wire rope with the necessary length and process the rope ends to protect them against untwining;
- put the new rope under the hoist and unwind it as shown on Fig. 25B.

Do not unwind the wire rope in the way shown on Fig. 25A.

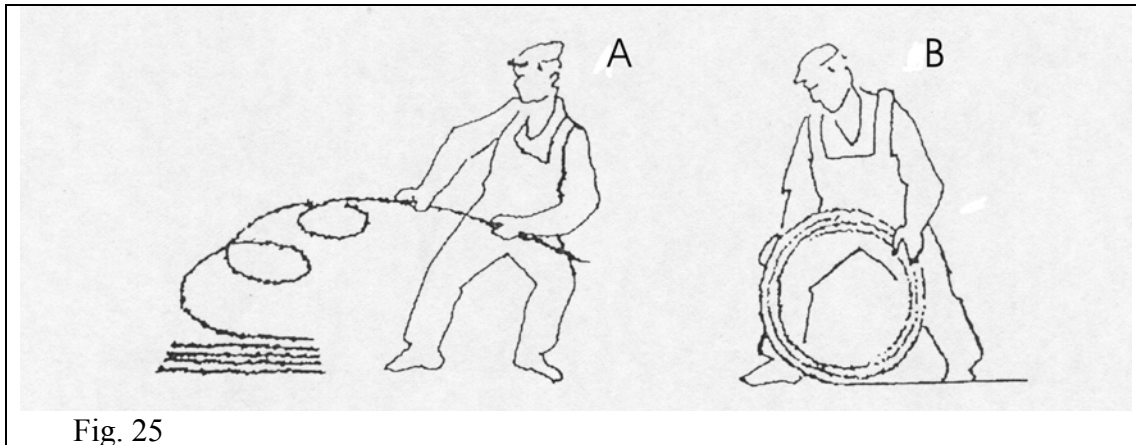


Fig. 25

- after fixing the wire rope to the drum, take the rope with hand and switch on the hoist for upward movement and begin to wind it;
 - after making five or six rope windings, switch off the electric motor;
 - the wound wire rope should be protected against unwinding by putting a wood cotter between the covered part of the drum and the longitudinal girder connecting the hoisting mechanism body flanges;
 - the remaining wire rope part is wound after the rope guide is mounted.
- For safety reasons it is recommended to manipulate the wire rope with gloves.

5.3. MOUNTING A NEW WIRE ROPE GUIDE AND ITS MAINTENANCE DURING EXPLOITATION

Before mounting a new rope guide it should be dismantled to its components (Fig. 24):

1 – guiding ring nut

2 – guide

3 – pressing spring.

The mounting sequence is shown on Figures 26, 27, 28, 29 and 30:

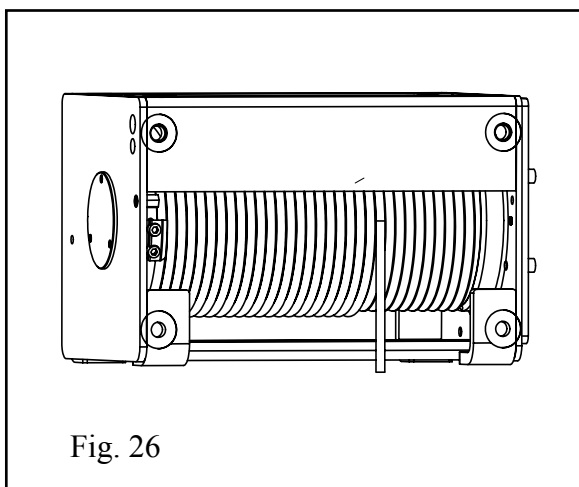


Fig. 26

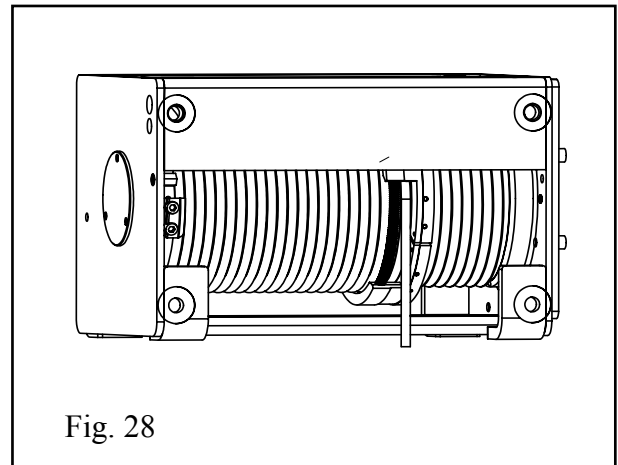
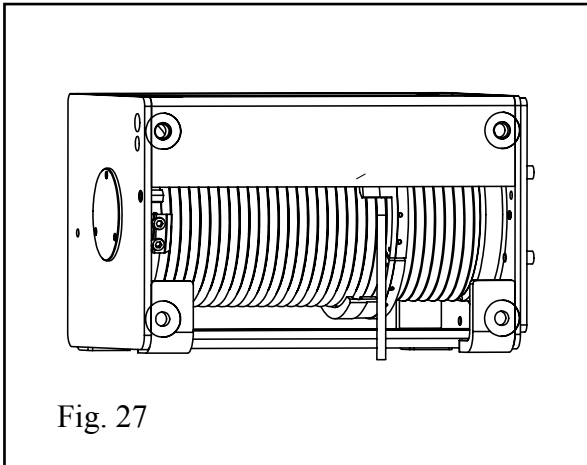
a) Lubricate with grease the guiding nut and the pressing spring channels.

Move slantwise the outgoing rope end (Fig. 26) upon the previous drum windings, stretch it tightly and fix it to the floor by foot, in order to avoid rope loosing after removing the wood cotter, which presses it.

b) Put the opened guiding nut on the drum and mount it in such mode that its windings go into the first channel next to the wire rope. The oblique rope is moved back into its initial position in the respective drum channel. Put the end sector of the guiding nut in such position that it is seen from the lower drum part.

c) Mount the pressing spring into the special channel of the guiding ring nut. Take both spring ends with other springs or hooks, stretch the spring to the necessary distance and clasp it (Fig. 27).

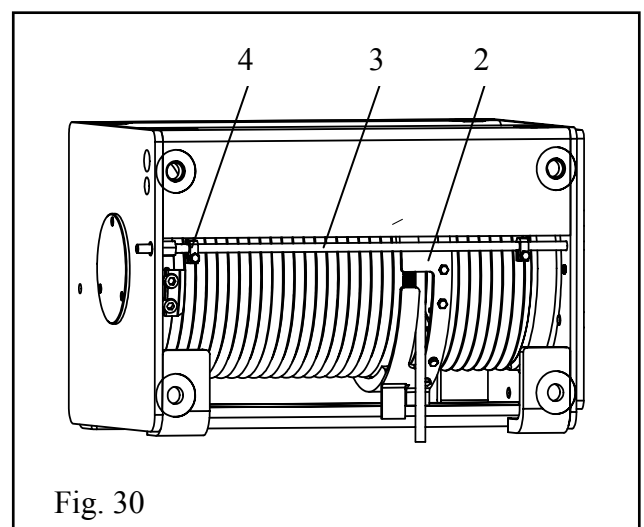
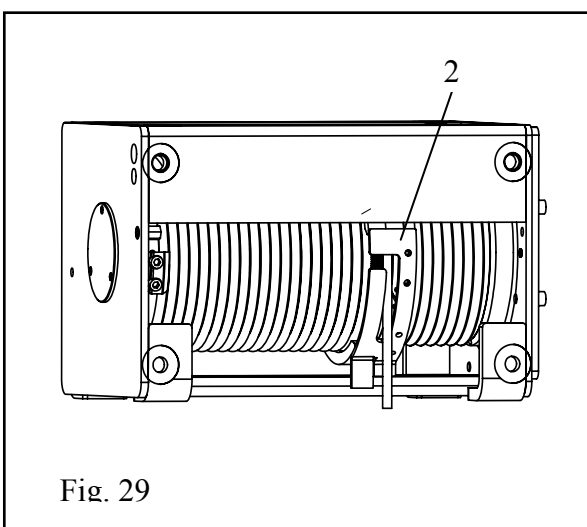
d) Put pins into the special openings drilled laterally (frontally) into the first and last sector of the guiding ring nut. By means of a movable key catch and pull the pins until the guiding nut lays closely onto the drum 3 (Fig. 28).



e) Put the wire rope free end into the guide 'window'. Move the guide 2 and place it upon the guiding nut. Connect the both sectors of the guiding nut and finally tighten it up to the drum (Fig. 29).

After mounting the wire rope guide, put the lever system 4 of the limit switch for the upper and lower end positions of the hook (Fig. 30).

At mounted rope guide the wire rope should not be loose.



The remaining unwound rope part could be winded till the desired position by pushing the button for upwards movement. The rope should not be twisted especially at the points where it comes through the rollers and where its other end is fixed.

After putting the cotter bush towards the body or the traverse, the rope branches should not be twisted or tangled. If such are observed, release the wire rope end from the cotter bush, untwisted the wire rope and put back the cotter bush.

Do not wind the wire rope till the drum end i.e. the hook should not reach its upper end position before the lever system of the limit switch is mounted and adjusted.

Before adjusting the limit switch, move the hook block till its lower end position and check if the first rope winding lays closely into the drum channel. In the opposite case, put the wire rope closely into the drum channel, hang some load onto the hook and stretch the wire rope tightly in order to achieve adjustment for upper and lower hook end positions (see p. 4.4).

If the wire rope length is changed during the process of exploitation (e.g. necessity occurred to prolong the wire rope), the limiting cramps (Fig. 30, Pos. 4) should be moved and their position on the bar readjusted.

5.4. OPERATION AND MAINTENANCE OF ELECTRIC BRAKE MOTOR

Maintaining the air clearance between the brake frictional lining and the friction surface (at released brake) within the determined limits is of prime importance for the reliable brake operation. It is done by adjusting the axial rotor run.

The initial (minimal) axial rotor run of the electric brake motor is set by the manufacturer. During exploitation the brake frictional material wears out and the braking path increases, respectively.

For the above reason periodical brake examination should be done. If necessary the brake should be regularly adjusted. When wearing out reaches the prescribed limits the brake should be replaced.



The brake stops operation if the axial rotor run reaches the value of 3.5 ... 4 mm.

The brake should be adjusted if the axial rotor run reaches the following values:

- for hoisting motor – 3.0 mm
- for trolley motor – 1.0 mm.

Adjustment and replacement of the brake depends on the electric motor type.
The variants are:

a) Brake adjustment of hoisting motor - (Fig. 31)

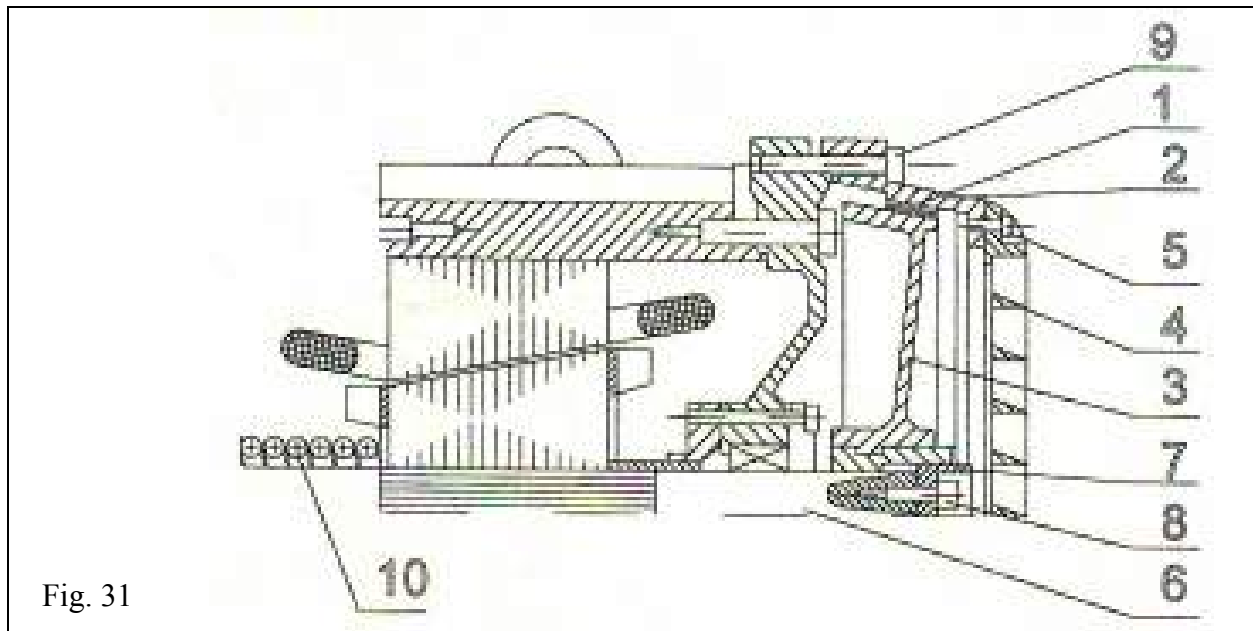


Fig. 31

Adjustment is done at unloaded electric hoist:

- unscrew the screws 5 and dismantle the ventilator grid 4;
- unscrew the bolts 8, which fix the adjustment ring nut 7 to the motor shaft 6;
- screw up to the limit the adjustment nut 7 by means of a special key supplied by the electric hoist manufacturer;
- unscrew the adjustment nut 7 until the normal axial rotor run is achieved (from 2.5 to 3.0 mm). The axial rotor run L received with every turn of the adjustment ring nut could be calculated by the following formula:

$$L = 2n, \text{ mm},$$

where 2 is the thread step, and n – number of nut revolutions at unscrewing.

The normal axial run is received when the adjustment nut is unscrewed 1/4 ... 1/2 revolutions starting from its fixed position;

- screw up the two stopping bolts 8 in order to fix the adjustment ring nut 7;
- put back the grid 4 and fix it through screws 5.

Brake replacement

When the frictional lining 2 wears out and its thickness becomes 1.5 mm, the brake should be replaced. The frictional material is glued to the brake ventilator 3. The replacement is performed in the following sequence:

- unscrew the bolts 9 and remove the housing 2 together with the ventilator grid 4;
- unscrew the adjustment ring nut 7;
- dismantle the brake ventilator 3 together with the frictional lining 2;
- mount a new brake 3 with frictional lining 2;
- adjust the axial rotor run following the above mentioned method;
- mount the housing 2 together with the ventilator grid 4.



The spring (Fig. 31, Pos. 10) could be replaced only in a specialized service.

b) Brake adjustment of trolley motor - (Fig. 32)

The brake disc of trolley motors actuates frontally. It is enough to change the axial rotor run slightly in order to return the initial rotor position of the trolley motor.

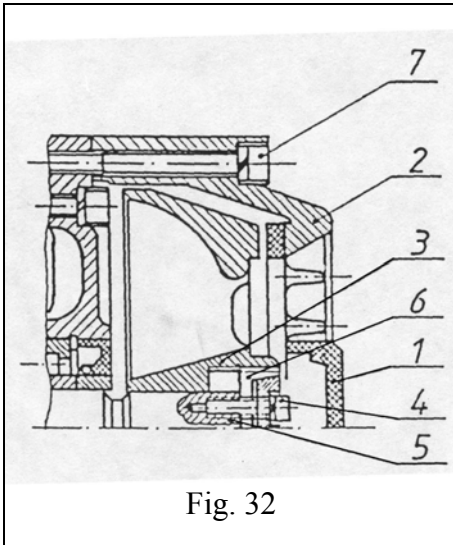


Fig. 32

Measuring the axial run

- remove the tap 1 from the rear end plate;
- measure the distance from the stopping bolt 4 on the shaft till the motor housing 2;
- push forward by hand the shaft 5 until it stops. In this position measure again the above distance. If the difference between the two measurements is more than 1.5 mm, the brake should be adjusted.

Adjustment

- unscrew the stopping bolt 4;
- screw up with special key the adjustment ring nut 6 by 1/2 revolution, which ensures axial rotor run of 0.5 mm;
- screw up the stopping bolt 4 to the limit;
- measure the axial rotor run and if it is more than 1.0 mm, or less than 0.7 mm, the adjustment should be repeated.

Replacement

- unscrew the bolts 7;
- remove the housing 2 together with the frictional lining on it;
- mount a new housing 2;
- screw up the bolts 7;
- adjust the axial rotor run following the above mentioned method.



The following requirements should be kept during exploitation and maintenance of electric brake motors:

- *the supply and protective wires should be well fixed in order to make good contact;*
- *all bearing nests to be fill with lubricant according to the Lubrication plan;*
- *the adjustment nut position onto the front motor plate should not be changed (it is fixed by the manufacturer);*
 - *at each brake adjustment the friction material thickness should be checked and if it is less than 1.5 mm the brake should be replaced;*
 - *the bolts on the rear motor plate and on the brake housing should be regularly checked and well tightened;*
 - *at motor maintenance or adjustment works do not contaminate the brake surfaces with lubricants.*

5.5. PLANETARY REDUCER MAINTENANCE

The planetary reducer maintenance consists mainly of checking the lubricant condition and its replacement. Keeping requirements for the lubricant quality, quantity and changing terms is of prime importance for the good condition of the reducer and its stages.

Before the first lubricant change the reducer should be washed obligatory. It could be done with benzene, benzol or other convenient liquid. For this purpose the electric hoist should be dismantled from the corresponding equipment and put down.

The electric motor and the flange are dismantled. All details for washing are taken apart. The remaining old lubricant is removed. The planetary reducer parts are mounted again in reverse sequence. At the same time the necessary lubricant type and quantity is applied (see Table 14).

5.6. TRAVELLING MECHANISM MAINTENANCE

The travelling mechanism maintenance requires mainly control over the wheels condition, examination of the tooth gears (especially the opened ones) and maintenance of the rail path.

The maximal allowed wearing out of the crown teeth of the driving wheels is 40% of the tooth thickness.

The maximal allowed wearing out of the wheel side walls is 40% of their thickness.

If the prescribed distance between the rail and the wheel side is increased (because of wearing out or for other reasons), the travelling mechanism should be adjusted in accordance with p. 4.8.1.

The travelling mechanism should not be used for dragging loads on the floor.

The electric hoist should be operated carefully in the buffer zones. Avoid shocks in order to prevent the buffers.

The oil level into the travelling mechanism should be checked periodically. When the determined term expires (Table 20) the oil should be replaced.

5.7. EXPLOITATION AND CHECK OF ROLLER BLOCK AND LOADING HOOK

Exploitation of wire rope rollers with cracks or missing parts is not allowed.

The admissible wearing out of the rope channel is 25% from its diameter. This applies both to cast iron and plastic rollers.

The loading hook should be checked regularly for cracks and deformations. They could be registered by measuring the control distance between the two marks onto the hook. They are notched in the specially designed zones on the hook end and the hook body.

If the corresponding control distance exceeds the following value the hook should be discarded and replaced:

Hook Number as per DIN 15401	0.5	1	1.6	2.5	4	6
Control Distance, mm	55 ^{+0.74}	70 ^{+0.74}	85 ^{+0.87}	90 ^{+0.87}	105 ^{+0.87}	130 ⁺¹

Besides it is necessary to perform periodical tests (see Table 10) for hook cracks and deformations according to DIN 15405.

5.8. ROLLING BALL BEARINGS

All rolling bearings, not belonging to the transmission mechanisms (planetary reducer), such as bearings of drum, electric motors, hook block, reeving rollers, travelling mechanism wheels, are lubricated by the manufacturer with enough grease.

Before lubricant change (in accordance with Table 13) all bearings should be cleaned and washed with extraction benzene (but not with petroleum). After that the bearing nests are refilled with grease till 2/3 level.



When dismantling the front motor end plate for replacing the bearing lubricant, do not change the adjustment nut position.

5.9. CARRYING SCREW JOINTS

The carrying screw joints are:

- hoist body – electric motor;
- hoisting mechanism – travelling mechanism;
- travelling mechanism – its reducer – trolley motor;
- roller hook block

These joints require periodical check and if loosening is found, they should be tightened with the necessary torque indicated in Table 12. All carrying screw joints have strength class, as follows: bolts – class 8.8; ring nuts – class 8. 8.

Table 12

Strength Class		Size, mm	M6	M8	M10	M12	M14	M16	M18	M20	M24	M30	M36	M42
Bolt	Nut	-	Tightening Torque, Nm											
8.8	8	Minimal	8.2	19.5	36.7	67.5	101.2	157.5	217.5	307.5	484.5	1100.0	1500.0	2370.0
		Maximal	11.0	26.0	49.0	86.0	135.0	210.0	290.0	410.0	646.0	1459.0	2090.0	3320.0

5.10. CONTROL BLOCK – PENDANT STATION, LIMIT SWITCH, CONTACTORS, OVERLOAD LIMITER

Checks and repair

The electric hoist smooth operation and high reliability depend on the good condition of its electric equipment. For these reasons periodical checks should be done and defects should be removed in due course.

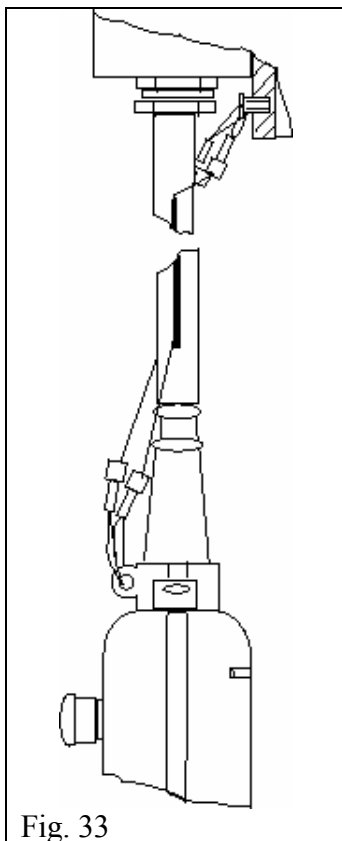


Fig. 33

The electric equipment checks are, as follows:

a) Daily check of the pendant station

The pendant station should be examined daily for visible defects. The electric hoist should not be operated if one of the following pendant station defects is noticed:

- body cracks;
- cable defects - its wires are visible;
- the pendant station cable goes out of its seal;
- defects in the carrying wires;
- loose carrying wire fixing to the pendant station or to the electric control panel (Fig. 33);
- loosened or damaged buttons.

The above mentioned defects should be removed by an authorized specialist.

Not so serious defect is lack or illegibility of the button designations, but it should be removed in due course.

b) Checks of electric appliances in accordance with Table 10 and p. 11

During preventive examinations the following should be taken into consideration:

- protective wires condition i.e. if they are well fixed to the protective terminals in the control panel;
- carrying wires fixing to the pendant station and to the electric control panel (Fig. 33). The carrying wires of the pendant station should be always stretched in order to avoid loading onto the command cable;
- seals of cable inputs into the control panel and the electric motors;
- condition of contactors, reducing transformer and limit switch;
- overload limiter condition;
- checking sensors for mechanical damage;
- checking electronic block of the overload limiter for mechanical damage;
- check for loose connections;
- checking the overload limiter adjustment.

During annual expert examinations it is obligatory to check the overload limiter action and to measure its actuation in accordance with the requirements of VDI 3570 Überlastungs-Sicherung für Krane.

5.11. LUBRICATION

5.11.1. Lubrication plan – Table 13

Table 13

Pos. from Fig.34	Lubrication Point	At first start					
		● At first maintenance after 3 months					
		● After 12 months operation					
		● Next maintenance after 12 months					
		● After every 36 months					
1	Reducer of the hoisting mechanism					● Checking lubricant quantity, adding if necessary. Lubricant change	
2	Drum – wire rope channels			●	●	Cleaning an lubrication	
3	Rope guide – spring channel and guiding profile edge		●	●	●	Cleaning an lubrication	
4	Wire rope		●	●	●	Cleaning an lubrication	
5	Levering mechanisms of the limit switch		●	●	●	Cleaning an lubrication	
6	Bearings of the rope rollers (if there are rollers) and hook bearings					● Lubricant change	
7	Bearings of the hoisting motor					● Lubricant change	
8	Bearings drum – body					● Lubricant change	
9	Cotter bush axle and roller traverse		●	●	●	Cleaning an lubrication	
10	Bearings of the trolley motor					● Lubricant change	
11	Coupling trolley motor – reducer					● Lubricant change	
12	Reducer of the travelling mechanism	●				● Oil change	
13	Grooves reducer –wheel shaft					● Lubricant change	
14	Wheel bearings					● Lubricant change	
15	Tooth crown of the driving wheel			●	●	Lubricant change	

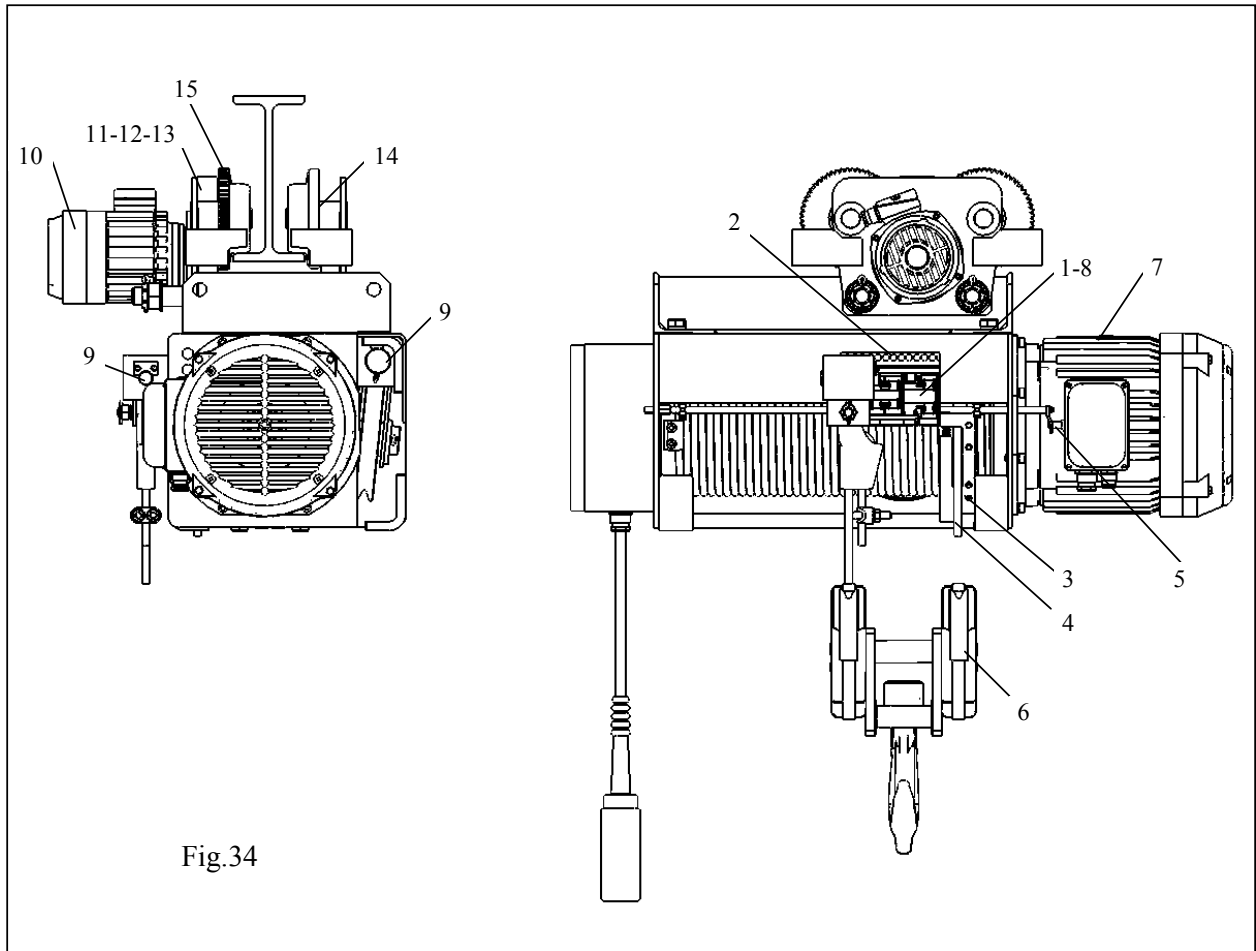


Fig.34

5.11.2. Lubrication materials – Table 14

Table 14

Lubrication Point (see Fig. 34)			Recommended Lubricants	Lubricant Quantity		
1	Lubricant Type			4	5	
	2	Parameters	3		Hoist Size	Quantity, g
						Pos. from Fig.34
					7	10
7 10	Consistent lubricant (grease)	Leakage temperature – not less than 180°C. Penetration – 220 to 340. Applicable for ball bearings of electric motors	Operation temperature -25°C to +165°C	VAT 10 VAT 20 VAT 30 VAT 40 VAT 50		
			Litol 24 GOST 21150-75, Fuchs RenoLit DurapLex 2, Shell ALvania EP Fett 2, Esso Unirex N 2, BP Energrease IS - EP 2, Aral Aralub FK2,		50	50
			Operation temperature - 40°C to + 220°C		60	50
			Fuchs Wacker Siliconfett Mittel, Aero Shell Grease 15A Siliconfett, Fuchs Wacker Siliconfett 300 mittel.		60	50

Table 14 - Continuation

1	2	3	4	5						
6 8 14	Con- sistent lubri- cant grease	Leakage temperature – not less than 180°C. Penetration – 220 to 340. Applicable for ball bearings in the general machinery	Operation temperature - 25°C to + 80°C	Hoist Size	Quantity, g					
			KZ BDS 1415-84, TSIATIM 202 GOST 11110-72, MOBIL-MOBILPLEX 48, BP Energrease HT 3.		Pos.					
				Operation temperature - 40°C to + 80°C	6	8	14			
					VAT 10	40	20	60		
				VAT 20	40	20	60			
VAT 30	40	20	60							
13	Con- sistent lubri- cant grease	Leakage temperature – not less than 180°C. Penetration – 300 to 340. Soap base: Li + Mo1S2 Applicable for carrying groove connections	Operation temperature -25°C to + 120°C	Hoist Size	Quantity, g					
			Aral Fett P64037, Aralub PMD1, BP Mehrzweckfett L21M, Esso Mehrzweckfett M, Mobil Grease Spezial, Texaco Molytex Grease EP2, Fuchs Renolit FLM2,							
				Operation temperature - 50°C to + 150°C						
					VAT 10	10				
				VAT 20	10					
VAT 30	10									
VAT 40	10									
VAT 50	10									
2 3 4 5 9 15	Con- sistent lubri- cant grease	Leakage temperature – not less than 95°C. Penetration – 220 to 430	Operation temperature -25°C to + 120°C	Hoist Size	Quantity, g					
			KZ BDS 1415-84, TSIATIM 202 GOST 11110-72, Aralub FDPO, BP Energrease HT-EPOO Esso Getriebfliessfett Shell Special H Mobil Gargoyle Fett 1200 W		Pos.					
				Operation temperature - 40°C to + 120°C	2	3	4	5	9	15
					VAT 10	50	50	50	5	40
				VAT 20	50	50	50	5	40	30
				VAT 30	50	50	50	5	40	30
			VAT 40	60	60	60	5	40	40	
VAT 50	60	60	60	5	40	40				
12	Oil	Вискозитет по ISO 220(150). Вискозитет 220 cst /40°C (150cst/40°C) Темп. на замръзване -25°C (-40°C) Температура на възпламеняване 190°C (180°C)	Ulita (TM-5) EP90 BDS 14368-82	Hoist Size	Quantity, kg					
			Rolana 90 (TM-4) BDS 14867-82, RM150IRM220 BDS 14867-82, Mobil-Mobilgear632, Mobil-Mobilube GX90, BP-Hypogear 90 EP, Shell Spirax Heavy Duty 90, EP 220 (Klueber, Syntheso, D220 EP, Esso S220)							
			VAT 10	0,300						
			VAT 20	0,300						
			VAT 30	0,300						
			VAT 40	0,300						
VAT 50	0,300									
1	Con- sistent lubri- cant grease	Leakage temperature – not less than 180°C. Penetration – 220 to 340. Applicable for planetary reducers	Ulita (TM-5) EP90 BDS 14368-82, Mobil-Mobilgear632, BP-Hypogear 90 EP, Shell Spirax Heavy Duty 90	Hoist Size	Quantity, kg					
			Operation temperature -25°C to + 165°C		Oil		Grease			
				VAT 10	0,150	0,300				
				VAT 20	0,200	0,400				
				VAT 30	0,200	0,400				
			VAT 40	0,300	0,600					
VAT 50	0,400	0,800								
		Litol 24 GOST 21150-75 Fuchs RenoLit DurapLex 2, Shell ALvania EP Fett 2, Esso Unirex N 2, BP Energrease IS - EP 2	Operation temperature - 40°C to + 120°C	Hoist Size	Quantity, g					
			TSIATIM - 201 GOST 6267-74 Fuchs Renolit 500 EP							
				VAT 10	10					
			VAT 20	10						
VAT 30	10									
VAT 40	10									
VAT 50	10									

5.12. POSSIBLE FAILURES INTO THE ELECTRIC APPLIANCES AND THEIR REMOVAL

Some failures in the electric appliances could be removed by the user. Possible failures, their discovering and removing are indicated in Table 15.

Table 15

No	Failure	Reason	Removal
1	Device cannot be switched on	1. Switched off fuse of the reducing transformer	1.1. Switch on the fuse
		2. Switched off fuse of the supply circuit	2.1. Replace with a new one
		3. Broken command circuit	3.1. Check the electrical circuit and restore it
		4. Broken or burned contactor coil	4.1. Replace with a new one
		5. Actuated or blocked limit switch	5.1. Check the limit switch and restore its initial position
2	When command button pressed and electric supply on, the hosting motor does not rotate in both directions	1. Stuck conical brake	1.1. Remove the ventilator grid and push the motor shaft repeatedly at switched off hoist, without load
		2. Mechanical blockage into the electric hoist or electric motor	2.1. Dismantle and remove the failure
3	The fuses switch off and the motor does not rotate when switched on	1. Short circuit towards ground	1.1. Check with megaohmmeter
		2. Short circuit between the phases	2.1. Check the phase insulation
4	Motor produces unusual noise	1. Worn out bearings	1.1. Replace with new ones
5	Electric motor groans and does not rotate	1. The motor operates only with two phases	1.1. Check the supply voltage, contact bridges and contact springs
			1.2. Check the contact system of contactors. Replace if necessary
		2. Low operation voltage, outside the prescribed for the motor	1.3. Check the stator winding of the electric motor
6	Electric motor overheats	1. Rated load exceeded	1.1. Keep the rated loading
		2. Asymmetrical voltage of the mains	2.1. Switch off the hoist until the voltage symmetry recovers
		3. The supply voltage is exceeded over the admissible level	3.1. Keep the voltage requirements
		4. The hoist loading regime is too heavy	4.1. Keep the normal loading regime indicated in the Passport
7	When command button released the electric hoist continue operation	1. Welded contacts into the contactors	1.1. Replace the contact bridges
		2. Stuck magnetic system of the contactors	2.1. Check the counteraction springs and clean the front surfaces of the magnetic conductor
		3. Welded contacts into the command commutator	3.1. Replace with new ones

Table 15 - Continuation

No	Failure	Reason	Removal
8	The limit switch does not operate and only its second stage works (the main contactor switches off)	1. Incorrectly switched supply cable	1.1. Exchange two phases
		2. Loose limiting cramps on the switching bar	2.1. Adjust and tighten the limiting cramps
		3. Stuck contactor for the corresponding direction	3.1. Unstick and replace the contactor if necessary
		4. Limit switch blocked	4.1. Check the limit switch. Repair if possible. Otherwise replace with a new one

5.13. NOISE DATA

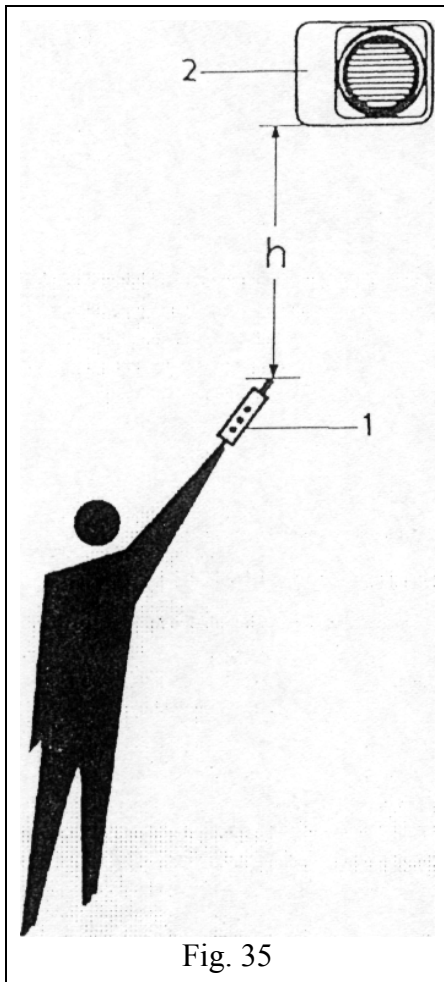


Fig. 35

The noise data are based on measurements effected under the following conditions:

1. Environment:

In exploitation premises or in open air without a plane causing echo.

2. Electric hoist operation regime:

The hoisting mechanism operates with rated loading at normal motor temperature and with maximal speed.

3. The microphone 1 of the sound measuring apparatus (Fig. 39) is situated at distance h from the electric hoist. The distance h is:

- 5 m – for electric hoists with lifting height up to 12 m;
- 10 m - for electric hoists with lifting height over 12 m.

4. The distance between the microphone 1 and the wall should be more than:

- 1.2 m – if measurements are done in exploitation premises;
- 3.5 m – if measurements are done in the open air.

Table 16 contains the admissible values of the sound pressure in dB as per scale A.

Table 16

Lifting speed, m/min			Electric hoist size			
<i>Reeving</i>			VAT 10	VAT 20	VAT 30	VAT 40
1/1	2/1	4/1	Sound pressure in dB as per scale A not more than:			
15	7,5	3,75	74	80	80	80
24	12	6	74	80	80	80

6. MEASURES FOR ACHIEVING A RELIABLE EXPLOITATION

The following rules are developed in accordance with FEM 9.755 and aim at taking measures for reliable operation periods during the whole electric hoist exploitation...

The main terms used in the present section and defined in FEM 9.755 are, as follows:

- **Theoretical exploitation $D(h)$** – the calculated total operation time of a serial hoisting mechanism for an exploitation period of about 10 years, classification as per FEM 9.511.
- **Actual exploitation $S(h)$** – it is calculated taking into consideration the operation hours, loading conditions and type of recording. The actual exploitation determines the efficient operation of a serial hoisting mechanism and its loading.
- **Total exploitation (h)** – the period from first start till final stop.
- **Period of reliable exploitation $(S.W.P.)$** – a period, for which the following relation is kept:

$$\frac{\text{Actual exploitation } S}{\text{Theoretical exploitation } D} \leq 1$$

When the actual exploitation period is less than the theoretical, the failure possibility is decreased to minimum.

ELMOT manufactures electric hoists in accordance with the loading groups defined by FEM 9.511 and ISO 4301/1. The particular hoist loading group is written in its Passport.

The theoretical hoist exploitation D according to FEM 9.755 is indicated in Table 17.

Table 17

Loading Regime Group as per:		FEM 9.511	1Am	2m	3m
		ISO 4301/1	M4	M5	M6
Designation	Loading conditions, K (Km)		Theoretical Exploitation, h		
1	L	light $K=0,5$ ($Km1=0,125=0,5^3$)	6300	12500	25000
2	M	medium $0,5 < K < 0,63$ ($Km2=0,25=0,63^3$)	3200	6300	12500
3	H	heavy $K=0,5$ ($Km3=0,5=0,8^3$)	1600	3200	6300
4	VH	very heavy $0,8 < K < 1$ ($Km4=1=1^3$)	800	1600	3200

In order to achieve reliable operation during the whole exploitation period, the following prerequisites are necessary:

- choosing a serial hoisting mechanism appropriate for the required loading as per FEM9.511;
- keeping the prescribed inspection intervals;
- periodical checks at least once per year;
- keeping the manufacturer's instructions for operation, inspection and maintenance;
- regular general repairs.

With increasing the exploitation period, the difference between actual and theoretical duration increases also. Hence the period until the first general repair, which determines the period of reliable operation should be corrected. For this purpose the user registers operation hours and loading regime during exploitation.

Annually (best at the annual general inspection) the actual exploitation period should be registered in the hoist Diary (Model 1). For this purpose the registered data for operation hours and loading regimes is calculated following the described in p. 6.2 methodology.

The user is responsible for the registers. On the basis of registered data, the authorized inspector checks if the actual exploitation has reached the theoretical duration.

A period of reliable regime of operation is present when the following condition is kept:

$$S(h) < D(h).$$

Otherwise, the user should organize a general repair. General repair is performed by the manufacturing company or by an authorized body. The manufacturer grants a guarantee for the new period of exploitation.

The calculation method is based on comparison between the actual exploitation period S and the theoretical D for the loading conditions regime 4 (very heavy). For example, if the electric hoist is designed for group 2m, the theoretical exploitation period for regime 4 is $D = 1600$ hours.

If the hoist operates only with partial load, then its theoretical exploitation D increases considerably. For example, if the electric hoist operates at half rated capacity, its theoretical exploitation period D increases 8 times.

6.1. RECORDING THE MODE OF OPERATION

The actual operation period $S(h)$ of the serial hoisting mechanism represents the effective exploitation, calculated from:

- working (operation) hours during the inspection interval;
- loading regime;
- corrective coefficient.

There are three recording modes divided in three classes:

6.1.1. Recording the operation regimes with memory (class 1)

The loading condition and the operation hours, respectively, are registered through appropriate devices. The actual duration of operation S is received by estimating the memorized data.

6.1.2. Recording the working hours with counters and recording the loading conditions by the user (class 2)

The serial hoisting mechanism is equipped with a time counter (or for distance gone) and with overload limiter.

6.1.3. Recording the working hours and loading conditions by the user (class 3)

The user records loading condition and operation hours, respectively, without use of special devices.

6.2. CALCULATION OF THE ACTUAL EXPLOITATION PERIOD

6.2.1. Calculation of the actual exploitation period if records are made in accordance with point 6.1.1.

The actual duration of exploitation S_i for the inspection period is determined by the formula (as per FEM 9.755):

$$S_i = (K_{mi} \cdot T_{oi}),$$

where:

i – inspection number in sequence;

K_{mi} – actual coefficient of loading condition for the time of inspection;

T_{oi} – number of operation hours for the time of inspection;

The serial hoisting mechanism operates within the S.W.P. limits until:

$$S = \sum_{i=1}^n S_i \leq D,$$

where n is number of inspections carried out.

6.2.2. Calculation of the actual exploitation period if records are made in accordance with points 6.1.2 and 6.1.3.

The actual duration of exploitation for the inspection period is determined by the equation:

$$S_i = K_{mi} \cdot T_{oi} \cdot f,$$

where:

T_{oi} - number of registered operation hours for the inspection period;

f - coefficient of the type of recording.

In p. 6.2.1 is described how to check if the theoretical period of exploitation is expired.

6.2.2.1. Coefficient of the type of recording

The actual period of exploitation depends on the type of recording. Recording is more precise and reliable if made according to p. 6.1.1 than 6.1.2 and 6.1.3. This fact is taken in consideration by implementing a coefficient f in the formula for S_i . The corresponding values are given in Table 18.

Table 18

№	Recording Mode	Coefficient f
1	Recording the operation regimes with memory	1.0
2	Recording the working hours with counters and estimating the loading conditions	1.1
3	Estimating the working hours and the loading conditions	1.2

6.2.2.2. Calculation of the work duration

The duration of operation is the time of hoist movement. It could be determined:

- by means of a counter – The counter records the time of hoist movement T_{oi} in hours.
- if there is no counter – The duration of operation for the inspection interval is calculated by

the following formula:

$$T_{oi} = \frac{2 \cdot H \cdot N \cdot T \cdot D_p}{60 \cdot V}$$

where:

V (m/min) – hoisting speed;

N – number of cycles per hour;

H – average lifting height for a cycle. A cycle means lifting + lowering.

T – working hours per day;

D_p – working days within the inspection period.

6.2.2.3. Calculation of the actual loading regime coefficient K_m

The actual loading coefficient K_{mi} for the inspection period is calculated by the user.

Table 17 contains K_{mi} values for the different loading regimes (light, average, heavy, very heavy) and its relation with the complex loading coefficient K : $K_{mi} = K^3$.

In cases when recording is done without memory, K_{mi} could be calculated using the following simplified method:

a) Drawing a simplified loading diagram

The loading diagram shown on Fig. 36 is drawn using the recorded data for loading and hours of operation. It represents change of loading Q as a function of time T .

For simplification is accepted that the electric hoist operates at the following loading types: $Q_N : 0.75 \cdot Q_N ; 0.5 \cdot Q_N ; 0.25 \cdot Q_N$ and without load, for which the following operation hours are recorded: T_1, T_2, T_3, T_4, T_5 , respectively.

Q_N - rated hoist loading capacity

The total recorded time of operation Toi is calculated, as follows:

$$Toi = T_1 + T_2 + T_3 + T_4 + T_5.$$

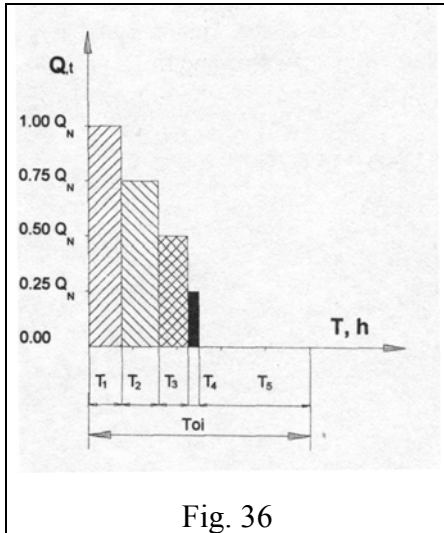


Fig. 36

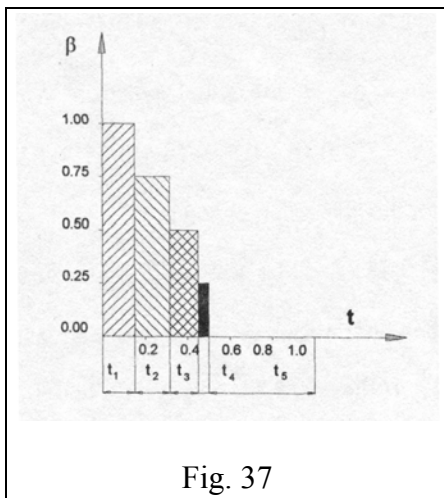


Fig. 37

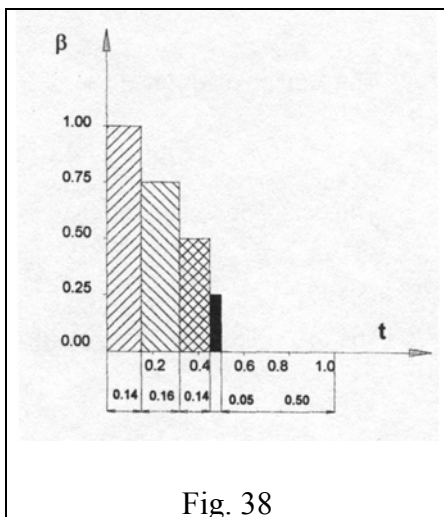


Fig. 38

b) Drawing a modified loading diagram

Next step is to modify the diagram on Fig. 36 and draw it in relative units (Fig. 37). For loading unit is used Q_N and for time unit – toi .

The relation between real and rated load $\beta = \frac{Q}{Q_N}$ is entered on Y-axis. Time values t_j (part of operation period at certain loading) in relative units is entered on X-axis.

The times t_j are calculated by the formula:

$$t_j = \frac{T_j}{Toi},$$

where $j = 1$ to 5.

At this simplified loading representation, relation β accepts the following values:

$$\beta_1 = 1; \beta_2 = 0.75; \beta_3 = 0.5; \beta_4 = 0.25$$

c) Calculating the coefficients Kmi

Using the diagram on Fig 37 the coefficient Kmi for the inspection interval is determined by the equation:

$$Kmi = \beta_1^3 \cdot t_1 + \beta_2^3 \cdot t_2 + \beta_3^3 \cdot t_3 + \beta_4^3 \cdot t_4$$

Using the simplified β values the received equation is:

$$Kmi = 1^3 \cdot t_1 + 0.75^3 \cdot t_2 + 0.5^3 \cdot t_3 + 0.25^3 \cdot t_4$$

The t_j values are taken from the diagram on Fig. 37.

Calculating the coefficients Kmi , the following should be taken into consideration:

- the rated load includes also the weight of load gripping devices;

- the above mentioned equations are in accordance with FEM 9.511, as far as the following condition is fulfilled:

$$\frac{\text{Gripping devices weight}}{\text{Rated load}} \leq 0.05$$

If the above condition is not fulfilled, then by calculating Kmi the 'dead load' should be considered. This calculation method is described in FEM 9.511.

After calculating the actual duration of exploitation S , it is compared to the theoretical duration D .

Example:

Assuming a first inspection of electric hoist with operation regime 2m (as per FEM).

The following data is available:

- Lifting speed - 24 m/min;
- Number of cycles per hour – 20;
- Average lifting height - 11 m;
- Working hours per day – 8 hours;
- Inspection interval - 250 days.

At type of recording according to p. 6.1.1, the hoisting mechanism operates at the following loading:

- 15% of time – at full loading;
- 16% of time - with 3/4 of rated load;
- 14 % of time - with 1/2 of rated load;
- 5 % of time - with 1/4 of rated load;
- 50 % of time – without load.

The operation time during the inspection interval is:

$$T_{O1} = \frac{2 \cdot 11 \cdot 20 \cdot 8 \cdot 250}{60 \cdot 24} = 611,1 \text{ hours}$$

The actual coefficient Km_1 is :

$$Km_1 = 1^3 \cdot 0,15 + 0,75^3 \cdot 0,16 + 0,5^3 \cdot 0,14 + 0,25^3 \cdot 0,05 = 0,2357$$

The actual duration of exploitation during the inspection interval is:

$$S_1 = 0,2357 \cdot 611,1 \cdot 1,2 = 172,84 \text{ hours}$$

After inspection the remaining theoretical period of exploitation is:

$$D = 1600 - 172,84 = 1427,16 \text{ hours}$$

After the calculations are made the results are filled in the hoist Diary – Model 1.

After reaching the theoretical duration of exploitation, the hoist could continue operation only after a general repair.

At type of recording according to p. 6.1.2 and 6.1.3, the general repair should be carried out at least 10 years after the first start of the serial hoisting mechanism (as per FEM 9.755).

6.3. GENERAL REPAIR

General repair means electric hoist checking in order to discover and replace all defective parts and all parts close to failure. The objective is to improve hoist parameters and to bring its condition close to that of a new hoist.

During repair works all safety requirements containing into the present Instruction as well is in the respective state standards should be kept.

General repair could be carried out only by ELMOT specialists or by a company authorized by ELMOT. All repairs should be documented into electric hoist Diary.

Table 19 contains a scheme for general repair. All details indicated in the fifth column should be replaced regardless of their current condition.

ELMOT specialists or a company authorized by ELMOT should perform the final examination and give permission for further exploitation.

The examination specialists determine:

- the theoretical duration of exploitation;
- the maximal period of exploitation before next general repair.

All data should be documented into the Diary (Model 1).

After the general repair the hoist is put into operation in accordance with the corresponding norms valid for the country where the hoist is exploited.

Table 19

No	Item	Check for Cracks	Check for Wearing Out	Replacement
	HOISTING MECHANISM			
1	Body	■		
2	Drum	■	■	
3	Wire rope		■	
4	Wire rope rolls	■	■	
5	Rope guide		■	
6	Reducer tooth crown	■	■	
7	Planetary wheel guides	■		
8	Planetary wheel axles	■	■	
9	Solar and planetary tooth gears			■
10	Brake disc	■		
11	Motor shaft	■	■	
12	Motor flange	■		
13	Hook with ring nut			■
14	Carrying plates	■		
15	All bearings			■
16	All rubber seals			■
17	Groove joins	■	■	
18	Limit switch			■
19	Commutation apparatuses			■
20	Traverse	■		
21	Frame	■		
22	Carrying bolts			■
	TRAVELLING MECHANISM			
1	Brake disc	■		
2	Motor shaft	■		
3	Motor flange	■		
4	Travelling wheels		■	■
5	Tooth gear axles	■	■	
6	All tooth gears			■
7	All bearings			■
8	All rubber seals			■
9	Carrying elements: sides, axles, pins	■	■	

