Design of a Small Movable Lifting Machine Overall Structure

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Abstract. The paper is mainly on the overall structural design of small movable lifting machine . First of all, it selects the main components, the need to include: H-K201 micro electric hoist, steel wire rope and bearing. Then it comes to the corresponding design calculation, including the requirements for welding, pulling force calculation, wire rope tension calculation, shaft and external dipole moment calculation. It also emphasizes the requirements of the crane. At the end, the paper summarizes the design process.

Introduction

The lifting machine is one of the large fixed machines, which is mainly used for lifting and conveying all kinds of heavy loads. The small elevator plays an important role in daily life. The power source of the host chooses the micro electric hoist, The three parts which are the motor, the reducer and the roller are connected by the coupling respectively. The motor is the power source, the reducer is the drive system and the roller is the execution and the control part, in which the reducer is the most important which uses quasi parallel torus worm. The worm bearing power is big, the dynamic pressure oil is stable, the noise is low and the balance temperature is low, which has both superior practical value and economic value.

Selection of major components

Selection of H-K201 miniature electric hoist. Electric hoist and electric hoist. Micro electric hoist is suitable for various occasions, which can enhance 1000 kilogram of subsequent goods. It is especially used in high-rise buildings when lifting heavy goods from the ground floor. It has the advantages of simple, dainty structure, convenient installation, little size. What's more, it uses one-way electricity as power source. Micro electric hoist has achieved the international standard in the production design and ensured the safety of the motor. The electric heat sink adopts cast iron structure, which improves the service life. Micro electric hoist can be utilized in the production and construction of factories, mines, agriculture, power, construction, dock, warehouse machinery installation, cargo lifting, vehicle handling and other operations. The rated voltage of the miniature electric hoist is 220V which is suitable for the workshop of the household and the three-phase electricity. Due to the target surface tension, two adults are needed to pull up, which weight is more than 1000 kilograms. It shows that the selection of H-K201 micro electric hoist fully meets the requirements.

Wire rope selection. Choosing appropriate wire rope can decrease the risk factors in use and the harm to people, machine, and can prevent premature damage. The choice of wire rope should not only considers the breaking force and twisting direction, rope, rope core structure, anti rotation property and lubricating property factors, but also takes into account the actual condition of heavy machinery. In order to improve the service life, wire rope should be as far as possible and the contact wire rope should not be chosen. It is not appropriate to choose the wire rope with high strength, and its strength should not exceed 2160MPa. The operating conditions of the lifting molten or hot metal shall be the asbestos core and the high temperature wire rope. From the above analysis, the wire rope diameter should be 6.

Bearing selection. Considering the action of radial force, 6306 bearings should be chosen. The dynamic load size should be 40.8KN which is static load and the size should be 24KN. Torque and shaft are calculated to meet the requirements. The speed limit in grease can reach 7000 rpm to meet the requirements. The bearing with various of bearing seats which are directly installed on the shaft.

Lower shaft bearings does not only need to bear the radial force, but also need to bear vertical pressure, so the thrust bearing is chosen. The size of the load should be 10.8KN and the static load should be 14KN. Axial computes torque to meet the requirements. The speed limit in grease can reach 3800 rotational speed in revolutions per minute. Due to the bearing selection, the bearing seal should, according to the common seal, use industrial wool to meet the requirements, which replaces comparison, reduces price and has very good function that effectively prevents debris in the bearing internal from influencing the service life of the bearing. So all parts adopt wool felt seals. Then it selects 6306 spherical roller bearings. Thrust bearing is 51206.

Design calculation part

Welding requirements. Selection of welding parameters. Through the analysis of the welding, the measures are as follows:

Selection of welding material

Due to the cold crack of Q345, steel tends to be larger and low hydrogen welding material, while the welding joint shall be strong as the base material with the principle of the selected model: E5015 grade: J507 or types: E5016 grades: j506 welding a.

Groove form: the K type groove, angle of 45 or 60 degrees.

Welding method: manual welding.

Welding current: in order to avoid the large weld micro structure, the impact toughness is reduced, and the welding of small specification must be used.

The specific measures are: The small diameter welding electrode, bead, thin layer, the multi pass welding. 3 times the bead width is less than the electrode, welding layer thickness is not greater than 5mm. The diameter of the first layer of the third layer is 3.2 welding electrodes. Welding current is 100-130A; the diameter of the fourth layer of the sixth layer is 4.0 bar welding of electrodes. Welding current is 120-180A.

Preheat temperature: before welding, preheating temperature is 100-150.

Tension calculation process. The technical parameters of the micro electric hoist for the micro electric hoist of the hoist

H-K technology data:

TYPE	Rated Volt (v~)	Input Power (w)	Rated Lift ing Weight(kg)	Lifting height(m)	Lifting Speed (m/min)	Packing dim-ension(cm)	G.w. /n.w. (kg)	Quan/ctn (pcs)
H-K201	230~ 50HZ	1150	200	25	15	53×45×19	41/38	2
H-K202		1350	250	25	15	53×45×19	43/40	2
H-K203		1500	300	25	15	58×28×35	38/16	1

The suspension type miniature electric hoist belongs to the miniature electric hoist, and the suspension type miniature electric hoist can only be used in the trolley car.

Model: HXS.

Rated starting weight: 100kg, 150kg, 250kg, 200kg.

Lift height: 20m.

Rising speed: 15m/min (150kg, 100kg) 12m/min (200kg, 250kg).

Gross / net weight: 28/27 30/29.

Rated voltage: 100/110/120/220/230/240.

The tension of the single hook is 200kg, which can meet the requirements. Therefore, H-K201 micro electric hoist is chosen. Seeing from Table H-K201, micro electric hoist height is 25 meters, lifting weights can be larger 200kg, the cut phase comparison is concemed and the price is relatively cheap, which is in line with the requirements.

Wire rope pulling force calculation. The minimum breaking of the wire rope is calculated according to the Ma core. The safety load is assumed by the design of steel truss or steel beam and the matching of the wire rope. If the wire rope end is used for other end connectors, the steel wire rope clip is recommended to reduce 25%, and the loss of aluminum alloy is recommended to reduce 10%.

Single pulley block S=Q/a η, where is the block rate, η stands for pulley efficiency.

The breaking strength of wire ropes is related to the wire breaking strength and the breaking tensile strength of wire ropes. Wire rope breaking force can be calculated by approximate formula: breaking force = 50 * diameter * diameter. Wire rope safety factor: for cable wind: 3.5. The diameter of wire rope obtained by calculation is 6.

Axis calculation. Firstly, the internal force of the circular shaft is analyzed, then the stress and deformation of the shaft are calculated, and the strength and rigidity of the shaft are calculated.

Calculation of the external force couple moments. 2.5.1

$$M_e = 9.55\times10^6 \frac{P}{n} \tag{1}$$

M e is N Torque (N • mm). Power P is power (W). n is Rotational velocity (r / min). Steering couple moment is generated by the input power of the driving wheel and the shaft in the same direction; arising from the output power of the wheel moment of the couple of the steering shaft and in the opposite direction too. According to the design data, in the formula, M e=9550*2.2/910=23Nm.

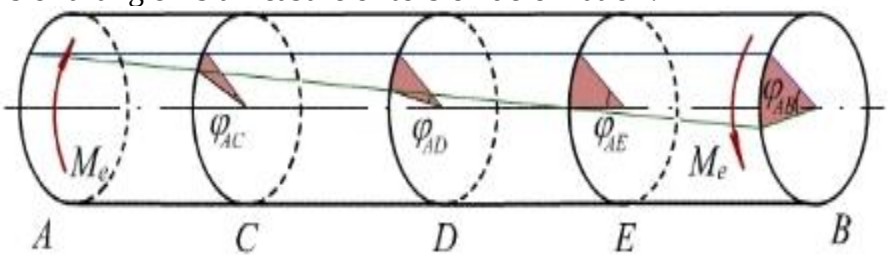
The moment of inertia and the coefficient of torsion cross section is the geometrical properties of the cross section. The size of the cross section is related to the shape and size of the section. Solid axis shaft solid is D, then:

$$I_p = \frac{\pi}{32} d^4 \approx 0.1 d^4$$

$$W_p = \frac{\pi}{16} d^3 \approx 0.2 d^3 \tag{2}$$

For the stepped shaft, because the torsional section coefficient Wp is not constant, the maximum working stress t max does not necessarily occur in the section of the maximum torque M t max. To take into account the torque T M and torsional section coefficient Wp, according to these two factors, determine the maximum shear stress t max.

Angle of Twist-the relative angular displacement of any two cross section when the shaft is twisted. Torsional angle f is a measure of torsion deformation.



Two the distance of the cross section is the larger the angle of torsion is.

Torque angle f of the straight round shaft is proportional to torque M T and the length of shaft L, and is inversely proportional to the polar inertia moment I P of the cross section, and the proportional constant G is introduced.

$$\phi = \frac{M_T L}{G I_p} \tag{3}$$

$$\Delta L = \frac{F_N L}{EA} \tag{4}$$

f is the torsional angle and the shear modulus of G is the material. If the section between the torque value change, or shaft diameter difference should be segmented calculated corresponding sections of the torsion angle are then superimposed.

The rigidity condition of the straight round shaft: the maximum unit length twist angle is less than or equal to the torsion angle of the length of the allowable unit.

Use requirements

If hoist is used as often as necessary, based on a base of the rack body placement on the concrete foundation, depth should not less than 1m. When it is used on the ground, rolling pile and rolling prison must be used and the base rolling pile should not be less than 8m. The angle of rolling pile is available for 75mm x 75mm. The driven underground depth should be 1.2m. The rolling piles at the top of the frame body must be connected firmly with the chassis.According to the design requirements, the concrete foundation being buried the foot should be connected with bolt frame body.

Conclusions

By the computer aided design software of CAXA electronic drawing board, detailed calculation and description of each important and necessary step are checked. Assembly drawings and part drawings in accordance with the habit of the national mechanical drawing standards. Through this design, the author becomes more familiar with the relevant standards, norms, technical documents and design specifications of preparation. The analysis solves the question and the ability has been improved. The comprehensive use of the knowledge can solve some practical problems in production.

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