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INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

Rozvodná zařízení

Elektrikář - silnoproud

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NĚMECKÁ VERZE

9.1 Abhängige und unabhängige Traktion

Ausstellungszug Siemens (1879)

Elektrotraktion in anderen Worten, die elektrischen Antriebsschienenfahrzeugen, vor allem Züge, Straßenbahnen, U-Bahn oder Obusse. Die wichtigsten Vorteile der Elektrotraktion sind weniger Verschmutzung und Lärm, höhere Energieeffizienz und niedrigere Betriebskosten. Wir unterscheiden ***unabhängige Traktion***, wo die Energiequelle der Bestandteil des Fahrzeugs ist und eine ***abhängige Traktion***, wo das Fahrzeug mit externen Führung getrieben wird.

Der Hauptnachteil des unabhängigen Antriebs ist die begrenzte Kapazität und ein großes Volumen von Batterien, bei dem abhängigen Antrieb sind es dann die Kosten der Netzleitungen. Ein besonderer Fall ist eine Kombination von Traktion, wie Diesel-Elektro, wo der Strom für das Fahrzeug durch das Verbrennungsmotor und den Generator hergestellt wird. Seit 1837 (Robert Davidson, Aberdeen), wurden mehrere Modelle und Experimente mit der unabhängigen Traktion, angetrieben galvanischen Zellen entwickelt, die keine praktische Bedeutung haben. Der erste elektrische Zug mit der abhängigen Traktion wurde von Werner von Siemens bei einer Ausstellung in Berlin im Jahre 1879 gezeigt. Zum Liefern von Strom verwendete er die dritte isolierte Schiene. Im Jahr 1881 bei einer Ausstellung in Paris zeigte eine ähnliche Bahn mit der Oberleitung in Form des durchgeschnittenen Rohrs, in dem sich der Schiebestromabnehmer bewegte. Im Jahr 1883 war in Mödling bei Wien die erste Straßenbahnlinie mit der Oberleitung eröffnet. Das Verdienst um die weitere Entwicklung hat vor allem Frank J. Sprague, Erfinder der Spannrolle, der im Jahr 1888 das Straßenbahnnetz in Richmond (Virginia) eröffnet hat. Die Straßenbahnnetze haben sich dann schnell in den USA verbreiten, während die Elektrifizierung der Hauptstrecken nur langsam vorschritt.

9.4 Fahrdrahtleitungen

Die Oberleitung der Schweizer Bahnen mit einer Spannvorrichtung

Querschnitt des Fahrdrahts

Moderne Einholmstromabnehmer. Am wichtigsten ist die abhängige Traktion, wo der Strom von externen stabilen Führung zugeführt wird. Es kann sich dabei um eine Oberleitung (Fahrdraht) oder Landleitung (Schiene) handeln.

Am wichtigsten sind die Systeme mit der Oberleitung, einen oder zwei Kontaktdrähte in der sicheren Höhe von etwa 4 m über dem Boden. Fahrdraht besteht aus dickem Kupferdraht mit einem speziellen Abschnitt "Oktal" gemacht, auf Stangen aufgehängt. Abschnitte des Stahldrahts max. Länge von etwa 500-800 m zu angespannt Gewichte und Riemenscheiben sein. Straßenbahnlinie U Kettenvorhänge sind häufiger, während die Eisenbahnlinie Wagen ist an einem Seil aufgehängt und Längsträgersäulen sind in einem Abstand von 30-50 m.

Ein weiteres Problem der abhängigen Traktion sind die Stromabnehmer. Die ursprünglichen Rahmen-Abnehmer wurden durch Hängestangen mit Rollenrutsch oder Scherplatte ersetzt. Neuere Entwicklung kehrt aber zu Einholmstromabnehmer zurück, die zuverlässig und für die höchste Geschwindigkeit geeignet sind.

ANGLICKÁ VERZE

1 SAFETY AND HEALTH PROTECTION AT WORK, INDUSTRIAL HYGIENE, FIRE PREVENTION

1.1 Safety and health protection at work on electrical devices

***Source**: The extract comes from the relevant standards and regulations adjusted for teaching the second grade apprentices of specialization "Electrician for heavy current".*

Formation of alternating current AC

Alternating current is generated in AC generators of power stations. We can get it from a socket of a wiring in distribution systems of AC voltage, for instance. We can prove the timing of AC voltage by using an oscilloscope.

In the European energy sector is used AC voltage at frequency of 50 Hz. Because during one period direction of voltage changes twice, also direction of alternating current changes, namely, hundred times in a second.

Construction of an alternator is modified so that the coil, in which alternating voltage is induced, is at rest (forming, so called, stator), and a magnet is rotating (rotor). Sampling of alternating current is provided with fixed terminals.

In the energetic sector, alternators are used, which are the source of three-phase alternating currents.

The effect of electric current on the human body

In spite of the fact that human body contains a large amount of water, yet puts resistance to electric current passing through it. The resistance depends on the path through which the current passes. Measurements revealed that the human body, placed in a normal environment, puts resistance of about 2 KΩ. This value is the average, since each individual is different. From these measurements it is evident that people prone to sweating or people with delicate skin (women, children) are in the greater risk of electric shock. Taking that the average response of men is 100% of current value than women react when it is 66%, and children even when it is 50% of current value.

Besides of the individual characteristics of a person it is important to know the type of current. Alternating current is with the respect to injury worse than direct current. The most inauspicious is alternating current in frequency of 500 Hz. With increasing of frequency above 1000 Hz, the effects of electric current on the human body are less inauspicious and at a frequency above 10,000 Hz are even sharply reduced.

The amount of current which passes through the human body influences the mechanism of injury by alternating electric current of frequency 50 Hz. Size of flowing current through the human body is possible to calculate according to Ohm's law. Safe limit - threshold detachment - is in alternating voltage of 10 mA for a healthy adult in current environment, for direct current voltage then 25 mA.

The effects of sizes of permanently acting current (mA):

1 mA	threshold of perception of el. current
1 – 8 mA	irritation in nerves, rising of blood pressure
6 – 15 mA	muscle contraction, personal will can usually relax muscles

15 – 20 mA	causes tetanus spasm, a person can not release
25 mA	tetanus spasm of the respiratory muscles
60 mA	vibration ventricle (ventricular fibrillation), temporary cardiac arrest
Above 80 mA	usually permanent cardiac arrest

Besides the current amount, everything depends on the time of current flow, both in terms of the duration of the passing, and also due to the immediate function of a heart. The heart is the most sensitive to the passing of electric current when the blood is expelled from the heart chamber. One cardiac period lasts about 0.8 sec. During the first contraction when the current passes through the heart, the person is able to withstand a current of the size of 1 A. During the second contraction only 0.1 A, continuously smaller and smaller size of electric current, currently does not cause significant health complication.

Questions:

1. Arising of AC.
2. Effect of electric current on human organism.
3. Size and impact human resistance to electric current, impact of frequency.

1.2 Labour-law issues of BOZP

It is given by the main document – Labour Code and another Work regulations – mainly 50/78, which divides workers in electrical engineering according to the educational degree and practice § 3 -11.

EA (electrical appliances)-

They are all EA determined for production, transmission, transformation, distribution and usage of electrical energy.

Risks –

Combination of probability and a degree of possible injury or health damage.

Electrical risks –

A source of possible injury or health damage by impact of electrical energy on a person or an user from EA.

Service and work on EA –

Include all activities necessary for putting into operation, controlling, switching, monitoring, maintenance also nonelectric parts.

Service of EA -

Working operations associated with working of the EA, e.g. switching, control - local, remote or central, regulation, monitoring, data reading permanently installed devices, synchronizing, inspection of equipment, etc.

During the operation, people touch only those parts that are designed for this purpose, using a set of personal protective equipment (PPE).

Working place -

Protection Area (PA) - the space surrounding live parts (without protective measures insulation level is not ensured)

Approaching Zone –

A demarcated area outside the protected area

Nominal voltage of UN system (permitted distance approaching)

to 1 kV 200 mm

3 kV 1120 mm

6 kV 1120 mm

22 kV 1280 mm

35 kV 1370 mm

Types of work on EA:

Working activity -

(Some electrical risks may occur

Work on EA (electro work) –

Testing, measurement, reparation, replacement, maintenance, assembling

Nonelectrical work –

Work near the EA, under which must be observed specified distances - with regard to voltage system, type of work, used equipment, qualifications of the person - (these include the following construction and other work: scaffolding, installation, working with, construction equipment, excavations, cleaning, painting).

Work under voltage –

A person is in contact with live parts, or interferes with body parts or tools, equipment and objects he or she works in OP. Persons must be properly dressed, do not wear metal objects (jewelry, watches, etc.) and they must have the appropriate PPE and work aids. They must take into account the surrounding environment. In places with danger of fire and explosion they may perform such work not earlier than after the elimination such effects. In the case of impending storms the work should not be initiated or conducted (with the exception of the interior space, protected against atmospheric over-voltage).

This work should be done by:

People trained or knowledgeable, but only under the direct supervision of staff with higher qualifications. Only specially trained people may do some work. Working under stress requires the use of a work order containing instructions for maintaining tools, equipment, and appliances in good condition, including their verification before the starting of work.

Work close to live parts –

A person inside the SA (secured area) who works to the Approaching Zone and interferes with his or her body parts or tools, equipment and objects but does not interfere into the PA

(protection area). Protection by covers to eliminate potential hazards, avoidance of contacts with live parts, and no interference into protecting area must be ensured. People must be verifiably instructed before they start to work, and boundaries of demarcated area must be defined.

Work on EA without voltage –

(No charge after verification by measurement), by meeting of the following requirements:

1) Disconnection (turn off)
2) Complete separation using insulation or air
3) Security against inadvertent switching (using your own lock)
4) Earthing and short-circuiting
5) Implementation of protective measures against live parts in near (physical distance required by voltage)

This work should be carried out by:

The people being in the know and people under supervision of a fully qualified person.

People:

A person responsible for EA (condition and operation) – The person must be chosen at every organization in accordance with the regulations.

People who work on EA -

Only the workers with required qualification can work on EA (Electrical appliances).

Questions:

1. Arising of alternating current and its influence on people's body.
2. Types of possible dangers occurring during work on EA.
3. Definition of „service of EA".
4. Principles of securing the working place.

1.3 Safety of technical appliances

Any electrical items (EI), which are used in electrical equipment (EE) must satisfy the conditions for the **safe and permanent operation**. It is therefore not possible to use randomly chosen conductive or insulating parts, which are not intended for that purpose or do not have valid **approval mark** for usage in electrical engineering. This means that each manufacturer must demonstrate, at putting new EE on the market, that the product meets all the requirements imposed on him.

This fact he proves by receiving the relevant certificate from electrical test institute, which examines the properties of EE, and provides it with an approval mark.

It is therefore always necessary to bear in mind that in the first place when working with electricity is user safety! Any no observance in technical procedures, or safety rules, can have dire consequences both for the customer itself but also the life of the entire EA. Electrician must be not only highly trained, but also responsible. If it happens that the

electrician, through their activities, unknowingly or accidentally affects the safety or operational characteristics of EA than there are his human and professional obligations, to eliminate the problem or ask for help. It is necessary to bear in mind that all concealed facts or temporarily repaired EA may not occur in normal operation but under difficult circumstances - rain, storm, frost, wind - will take effect for sure. Than that is a much bigger problem to eliminate potential complications, than to prevent them!


Approval marks of electrical items

Questions:

1. Define the term "electrical items".
2. Purpose of approval marks for "EI".
3. Principles for work on electrical appliances**.**

8.1 Pole and internal

Pole TS are located both on HV poles - to power small objects - the gamekeeper's lodges, solitary objects etc, or are dealt with separately placed poles. For various performances there are used single-pole, double-pole, three-pole or four-pole arrangement. The arrangement is selected according to the size and weight of the transformer itself to ensure the required mechanical strength for the placement of a separate transformer, switchboard, and the total equipment TS. These types of TS are used where their high voltage supply lead through outside area and unsightliness does not mind. Their advantage is low cost..

Internal TS kiosk

It is a solution of the covered TS with cable VN entry and cable outlets nn. Its advantage is the possibility of placement in residential areas without interference of outside visible wiring. Thanks to the unification, its price is a bargain. It is protected against the weather conditions and lower maintenance requirements.

It is not suitable, however, for the historic parts of a town, just for its unification. There it could cause intrusive impression.

For these cases are TS designed the way to fit into the environment so as not to be a disturbing element of historic centres of towns and buildings. It's an elegant solutions, but significantly more expensive.

Kiosk trafostation

Questions:

1. Realization and importance of pole transformer stations.
2. Use, advantages, disadvantages of kiost traformer stations.
3. Use of transformer stations placed in historical areas.