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EXPERIMENTAL DEVICE CONSTRUCTION FOR TESTING OF WIRE BY TWISTING

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ABSTRACT
In paper is described design of experimental device for technological testing of wire by twisting. Technological test is normalized by STN 42 0421 (ISO 7800).
Keywords: construction, wire testing, twisting, experimental device

1. INTRODUCTION
For examination of wire material plasticity is STN dictated these experiments:
- experiment of wire by oscillating bend,
- experiment of wire by spooling,
- experiment of wire by twisting.

Potential goals of paper are following items:
- analysis of knowledge,
- design of experimental device,
- calculation and dimensioning of device,
- drawing and technological documentation.

2. MATERIAL AND METHODS
Experiment of wire by spooling
Specifications of experiment are described in norm STN 42 0420. Principle of experiment consists in wire spooling on given diameter spike. Usually is using same diameter like is wire diameter. In table 1 are specified attributes for experiment.

Table 1. Prescribed values for wire test by coiling

Wire diameter d(mm)				Base dimensions		
Steel		From other metals		D (mm)	Z (mm)	A (mm)
above	to	above	To			
-	1,18	-	1	5	1,5	15
1,18	2,65	1	2,5	10	3	20
2,65	3,55	-	-	15	3	25
3,55	5	2,5	6	20	3	35
5	7,1	6	8	30	3	50

3. TESTING OF WIRE BY TWISTING

Specifications of experiment are described in norm STN 42 0421 or in ISO 7800: 2003. Rolled and drawn wire to 10 mm diameter can be tested. Testing length of wire is scale by wire diameter.

$$d = \sqrt{\frac{4 \cdot S}{\pi}} \quad (1)$$

Principle of experimental devices is on picture 1.

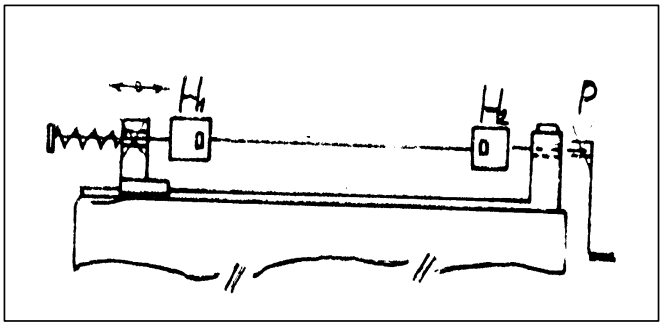

Figure 1. Scheme of device for wire testing by turning

Wire is bind to bites H1, H2 to axis of device. Bite H2 is rotary and is connected with cycle counter (P). it is use for registration of rotary head number turns, which wire stand to breaking. During twisting is changed primary length of wire therefore is bite H1 horizontally adjustable. This motion is limited by spring with small tension force (circa 2% force necessary to wire break). Device can be with hand or engine traction. Wire to diameter 3,15 mm are twisted by tempo around 60 rpm. Wire with bigger diameter is twisted by tempo 30 rpm.
Is it possible use three ways of loading:
- single direction twisting (it is most frequently used way),
- cyclic twisting (direction of revolving is cyclic changed),
- binary twisting (two wires are revolving clamped abreast).

One rev is rotation of bite about 360°. Measure of material plasticity is quantity of revolutions to break of wire.

4. RESULTS

Proposal of device base parameters and its design
Maximal diameter of experimental wire is 10 mm. minimal diameter of experimental wire is 0,1 mm. distance between clamping bites is maximum 300 mm. Type of bites are smooth (for wire 0,1mm ≤ Ø D < 0,3 mm), little serrated (for wire 0,3mm ≤ Ø D ≤ 3 mm), with groove of type V (for wire 3mm < Ø D ≤ 10 mm). Electronically revolution counter is part of device.
Device (pic.2) is designed for laboratory testing material by twisting. On left side is electromotor and gear box. It is fixed screw to base chassis. On input is pulley with diameter 100 mm and on output is rotary clamp bite. On opposite side of device is non-rotary sliding bite put to axis of wire.
On device be situated pre-stressing part. This part is using for stretching of wire in direction of device axis. Installed micro-switch is signalized to counter break of experimental wire.
Counter of speed is above gear box. Whole device is installed on fixed table. For power drive is using single-phase electromotor with nominal performance 600 W and speed 1440 rpm. Motor is installed on stretching device set on left side at gear box. In construction was chosen after calculation screw gear box of type NMRV 063 with ratio i = 50, n_2 = 58 rpm, M_2 = 67 Nm^{-1}. belt gear is covered by sheet shield. In front of gear box is switch of electromotor and counter.

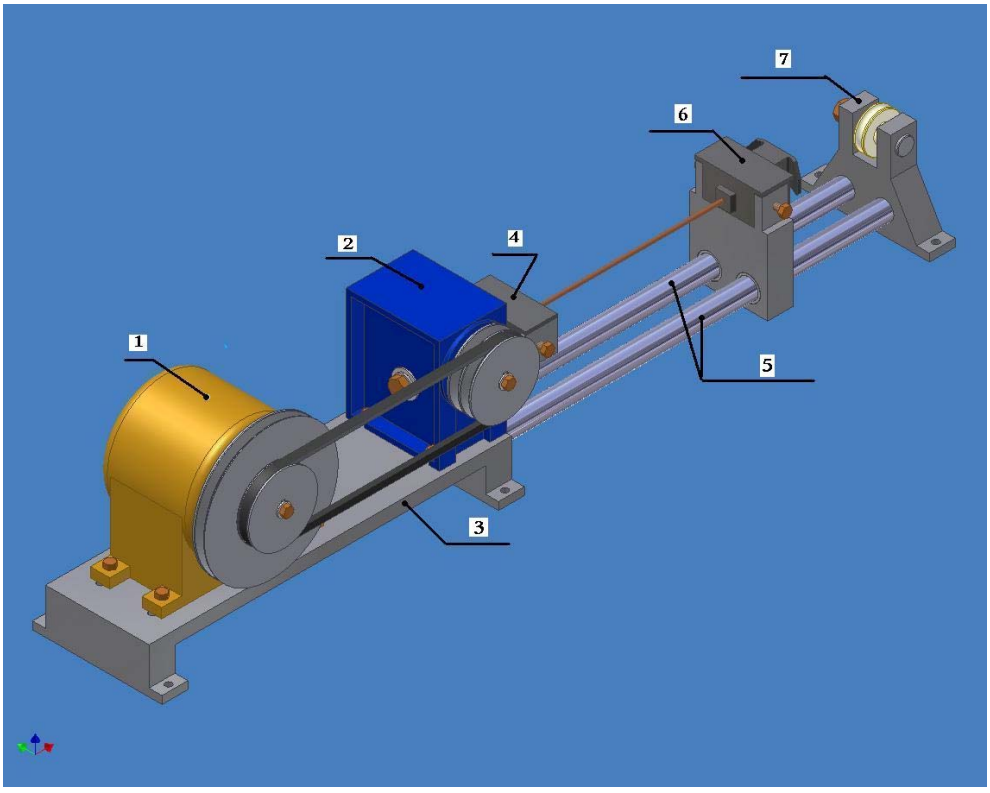

Figure 2. Device scheme: 1. electromotor, 2. gear box, 3. left console for gear box and electromotor, 4. rotary shattering head, 5. line slide way, 6. sliding shattering head, 7. tensive mechanism

Describe of technological experiment principle on device
1 - testing wire is put to experimental device so that them longitudinal axis was identical with clamp bites axis.
2 - follows is one clamp bite rotated by adequate constant speed until is wire break or is accomplished limited number revolutions. Full number of bite to break wire is accepting.
3 - for wires from steel, Cu and its alloys, Al and its alloys can not extend testing speed for given diameters values presented in table 2.
4 - if number of revolutions meet the given norm result is well without regard for location of breaking. If number of revolutions did not accommodate to norm requests is test invalid and must be do again.

Table 2. Testing speed

<table>
<tr><td rowspan="2">Diameter d,
or characteristic dimension D(mm)</td><td colspan="3">Maximal numbers of revolutions per second</td></tr>
<tr><td>Steel</td><td>Copper and copper alloys</td><td>Aluminium and aluminium alloys</td></tr>
<tr><td>d(D)<1</td><td>1</td><td>5</td><td rowspan="6">1</td></tr>
<tr><td>1≤d(D)<1,5</td><td rowspan="4">0,5</td><td>2</td></tr>
<tr><td>1,5≤d(D)<3</td><td>1,5</td></tr>
<tr><td>3≤d(D)<3,6</td><td>1</td></tr>
<tr><td>3,6≤d(D)<5</td><td rowspan="2"></td></tr>
<tr><td>5≤d(D)≤10</td><td>0,25</td><td>0,5</td></tr>
</table>

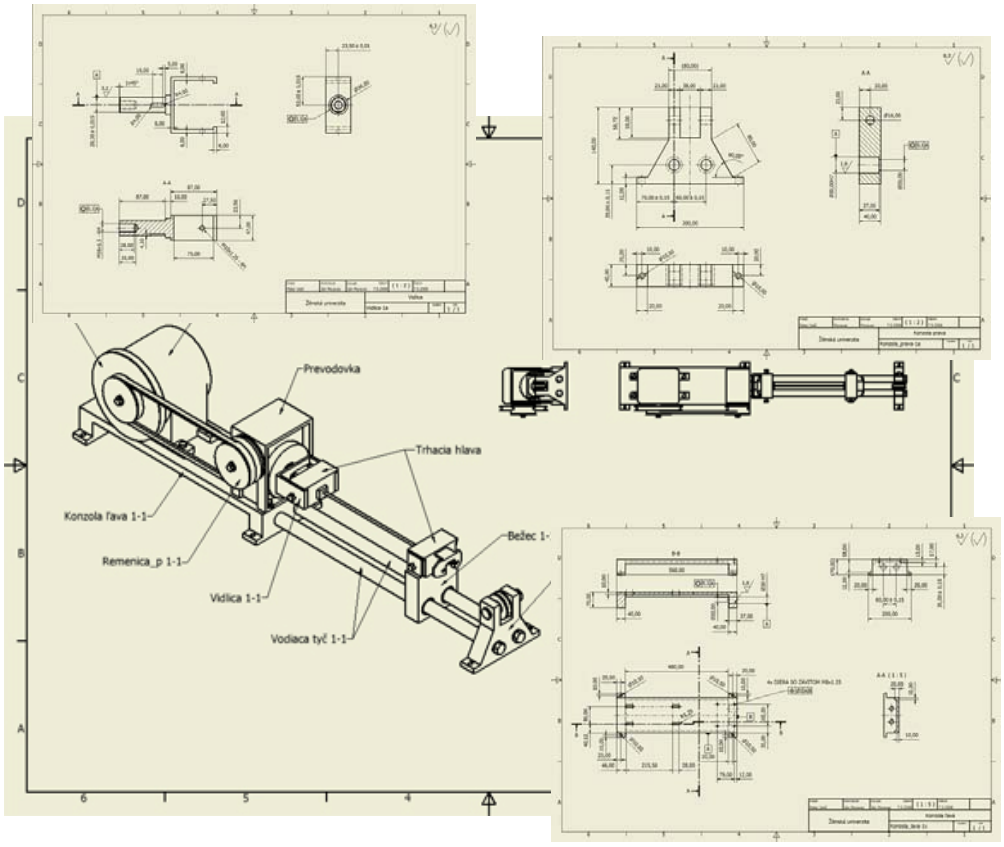

Figure 3. Design documentation of experimental device

5. CONCLUSION

Main object of paper was design construction of laboratory testing device for test of wire by twisting. Had to be calculated and specified needs dates (calculation of electromotor performance and gear box) for consecutive design solution. From that was derived design of simple parts and subassembly of configuration. Whole device configuration and details was made. Production technology of parts and whole device configuration was made. Construction was made in CAD system Autodesk Inventor 2008.

6. REFERENCES

[1] Jančušová, M.: Konštrukcia výrobkov z plastických hmôt. Nekonvenčné technológie 2005, vedecká konferencia ŽU Žilina, marec 2005, ISBN 80-8070-373-6.
[2] Kuba, J.: Process parameters analysing with aspect to technological product preparation. Academic Journal of Manufacturing Engineering, Number 2/ 2007, Editura Politehnica, Romania, ISSN 1583-7904.
[3] Skočovský,P.;Bokuvka,O.; Palček,P.: Náuka o materiáli, VŠDS-EDIS Žilina 1996
[4] Židek,M.; Sommer,B.; Dědek,V.: Tváření oceli, Praha 1988

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