TIGHTING SURFACE IN ELECTRIC MACHINES
IS POSSIBLE SOMETHING TO CHANGE?

ĐOZIĆ SALKO B.Sc. "RADE KONČAR" Generator Factory, Zagreb -Yu

ABSTRACT:

It is necessary to provide shot peening of many items of electric equipment to arrive of high quality. Where is requirements for guaranteed mechanical properties must be introduced in process shot peening with all followed workmanship and checking. Quality of tighting surfaces to be seriously studied and examined. Failures on these surfaces can cause many undesired effects. That means quality of workmanship of these surfaces to be verified by many known methods. Very important that the hardness uniformity to be dispersed equal on whole this area. Such deviation of hardness values on the metallic faces to be discovered by some methods. If we use such way surely in process of production we will rise quality of some metallic items. Shot peening help us. Shot peening making metallic surfaces harder. For tighting joint in electric machines that is very important. It is our main aim.

KEYWORDS:

Fatique strength, friction, wedge, contact surfaces, tighting surface joints, ideal technical smooth surfaces, hardness, distribution and uniformity of equal hardness.

To have satisfied joint between two pieces that means to have something very fixed and attached. That means as well is not possible any movement. In elecrtic rotation machines such are all types elecrtic motors and generators tighted joint makes two parts very strong and compact wholeness. On the normal speeds and overspeeds this joint doesn`t permit any moving between two parts. To have satisfied joint is necessary to fix wedges. Surface tighting between two wedges is very important. Exact made ground and smoothed surface must be perfectly as ideal straight and plane surface. Each part of this prepared surface must have full contact with other surface with other wedge. To say ideal may be is something far from praxis and life. Because in the daily life everyday in factory in work rarely we meet ideal things. As we know fabrication such metallic surface perfectly "ideal" made is very difficult to reach it. Properly we know that in nature in life in industry somethint ideal no existing. To have perfectly ideal metallic surface for full tighting contact with other surface is not possible. Theoretical exact necessary prepared surface many experts and engineers considering only as theory and science. How much is possibleto come near to ideal stage of surface is one measure of capacity and guality of technological process and available mechanical tools and machines for cutting, grinding, machining, honing, boring, reaming and smoothing. Different ways existing for checking these surfaces. On the figuras 1. and 2. we see items 1 and 2 where coming contact tighting surfaces and should be treated as is told previously. These tighting surfaces are indicated on the figs. 3 and 4 with small letters a, b, c, d. These surfaces must be in contact if we desire to have satisfied joint if we have such contact of whole surface of 60-70 % in contact. All others is allowable to not be in contact to be empty. In elecrtic machines or turbines shaft fittings and couplings to be exact in tollerances placed. On the figs. 1. and 2. is indicated items with guide bearings in vertical electric generators. They all making rotation with machines and all these items together with shaft must be attached as claiming normal workingspeeds and during testing some of the overspeeds. On the figs. 1. and 2. is not possible is not allowable appearence some more loosing and moving what is not in function of whole machine with turbines and other parts of powerhouse.

EXTREME CASES

In some cases we can suppose that some joints in electric machines existing in full function, when we have rough surfaces. Rough contact surfaces of two wedges or two contact parts can staying in excellent condition during life of machine. In praxis and in theory is necessary avoiding rough surface to be in contact by friction forces. Science says that one time friction forces keeping joint quasy quiet. But forecast as well says that one day forces of friction cannot be continual and this tighting joint collapsing. There for these inclined contact surfaces must be made by exact: machining, reaming, grinding and final smoothing to reach desired surface for contact with othed surface. Many factor and methods existing for research and checking of one roughness or smooothness of treated surface. Full contact between surfaces as we told before is ideal, but ideal in nature life and work to staying. On some ideal point of machining is not possible to arrive. Therefore results of examination given us what is applicable for work. Surely ideal 100 % contact not going. IDEAL SMOOTH SURFACE is this stage of fabrication grinding or smoothing when we arriving getting far better and better. But one moment time arriving when we cannot get nothing more better despite our continual and ubrupt activity. This stage when is not possible to get more this stage is ideal smooth surface for that material. Each material has looking this its proper stage when is not possible in any way to get more smooth surface. It is ideal straight and smooth surface.

IDEAL Technical Smooth Surface

In accordannce with vision of very known Profesor at Mechanical-Shipbuilding Faculty of University Zagreb S. Šilović ideal technical surface coming then when further working on the treatment of one technical metallic surface not increasing smootness. That means with further our intention and work smoothness remains same and no changing. That means we must to stop the work. That means with removing some roughness on the surface by machining we arriving on the one stage where is not possible to go more. Our metallic item is arrived on the one maximum. Further work of decreasing roughness and increasing of smoothness is useless. That is one definition, but it can have many objection and incorrectness. For checking quality we can use some devices as indicated on the fig. 5. With this device we can check hardness of surface by metallic tops in form spheres or conic with springs and guides. On the figure 5. is possible to see item 1. levera for pushing or pulling the device. Item 2 indicated as loosing hammer. By press these conic or sphere tops falling-hammering on the surface by elastic springs and item 3. is inducated hand-wheel for lift all these tops. That is same as measuring of hardness by different methods Shore, Rockwell, Brinnel and Vickers. On this way we can see and check where is metallic surface smoother or harder. This device can show us really where is surface failures. Item 5. is shocking shots what hammering on the metallic surface on the equal distances distributed on whole surface i checking. On the figure 6 is presented the way of shot peening by hammering shots together with compressed air. This is way to be used for repairing metallic surfaces. Nobody today considering as applicable way because to much dust creating around pistol. This is of course not healthy. On this way we can make the betterment of mechanical properties metallic surface. On this way we can be more safe if surfaces of the wedges would be treated. We cannot to place one wedge with not sufficient hardness. Usual main projectant claiming that all parts in the vicinity of wedges must have guaranteed hardness, otherwise this failure can cause moving within one to two milimeters - what is fault for whole machine. On the fig. 7. is presented one typical wedge with section A-A. Checking of tighting surface to be done on the way as we see on the picture 8. On equal distances some point can be measured hardness of wedge surface. But if is not satisfied some points will be taken for repairing and correction by shot peening or by water peening what is more healthy, because not appearing pollution and dust what is big caution for labour working with this plant.

Another way most in use is checking tighting surface of wedges is one generator or electric motor during assembly in factory. This way is to make couting by fresh paint this slots where coming wedge. After placing the wedge we are pulling out and see some face painted some no. Where is no that means no contact. If we have 60-70 % painted face it is acceptable. If is less wedge must go for repairing of surface properly on these points without paint. That is one quickly test for approval or disapproval workmanship wedges, what coming in one generator of 15 m rotor some pair tons. That is big task and obligation of people for adjustment and final correction of thousands such wedges to be installed in body of such generator or such big electric motor.

PEENING BY WATER

For betterment quality surface of wedges for tighting is necessary to use othe unclassical methods. Shot peening causing to much metallic dust and menace to human health. That means labours working to be special protected. Respirator protects of labours face and nose of dangerous metallic supstances what causing many ills some of the professional. Therefore peening by water is more healthy. Only creating water steam to be suction channel or ducts removed. Metallic surface for wedges on this way will be better arranged and fabricated. Therefore contact metallic surface of one wedge will be on this way better and uniformly dispersed on whole area. That means on each quadrat unit of face hardness and yield point will more-less equal.

This is better than shot peening by metallic parts hammering. In many tasks of projects for new electric motors and generators Desinger in specification of tighting jiont putting aim: all metallic parts must have guranteed hardness and other mechanical properties.

To put these wedges on the peening by water or shots is purpose fullfil these basic task to have verified and tested pieces going in the core of such electric machine.

FORCE ARRANGEMENT

On the tig. 10. is presented which forces acting on the one typical wedge with two tighting surfaces. Puching force for final placement of wedge in tighting joint is equal to pulling force. on the bottom and upper surface under pressure creating friction forces Kl. and Kr. u is indicated as coefficient of friction usual is value 0,13. From these vertical and horizontal components becoming resultant force indicated with R. Because wedges surfaces are under specific pressure, they creating force Kp. It is getting by surface b.1 as visible on the section multiplaying with pressure P and lateral force is getting on same way surface 0,5 h.1 multiplaying with specific pressure Pb. Of course that all forces of wedge depending of angle and inclination of acting resultant force R. Task of such wedges section: width b, and height h, has main aim: to keep stiffening joint during rotation of motor or generator.

In some dangerous cases disaster or electric currency shock one generator in powerhouse changing direction of rotation and working some time as asynchrone motor. It is time of energency. Wedges in boths cases must keep tighting joint fixed and strong to prevent further heating and destruction of machine before all parts rotor. All these previously mentioned cases to be respected and wedges with tighting sufraces to be installed in rotative machine in approved and tested excellent contidions for normal duration of work and general safety of powerhouse with switchyard.

CONSLUSION:

All these above mentioned methods for betterment of tighting joints to be done and investigated regarding hardness and other mechanical properties on the way by shot and water peening. These things to be dedicated to huge hydrogenerators and electric motor where till today classical methods is not sufficient.

References:

(1) ĐOZIĆ SALKO "Peening by water" ICSP-2
Chicago, Illinois May 1984 pp 37-38

(2) ĐOZIĆ SALKO "Unterlagen zum Fundamentieren von Stahlkonstruktionen"
Werkstatt und Betrieb 119
Carl Hanser Verlag München 1986 pp 807-808

(3) ĐOZIĆ SALKO "Additional Shot Peening for Workship"
Shot Peening, Science, Technology, Application
DGM-Verlag West Germany 1987 pp 163-168

(4) I.-Y Guedou:
Effect of Shot peening conditions on fatigue strength of two alloys-for-turboengines disks ICSP-3 Garmisch-Partenkirchen 1987 pp 459-466

(5) R. Kopp ond H.W.Ball
Recent Developments in Shot Peen Forming ICSP-3 Garmisch - Partenkirchen 1987 pp 297-308.

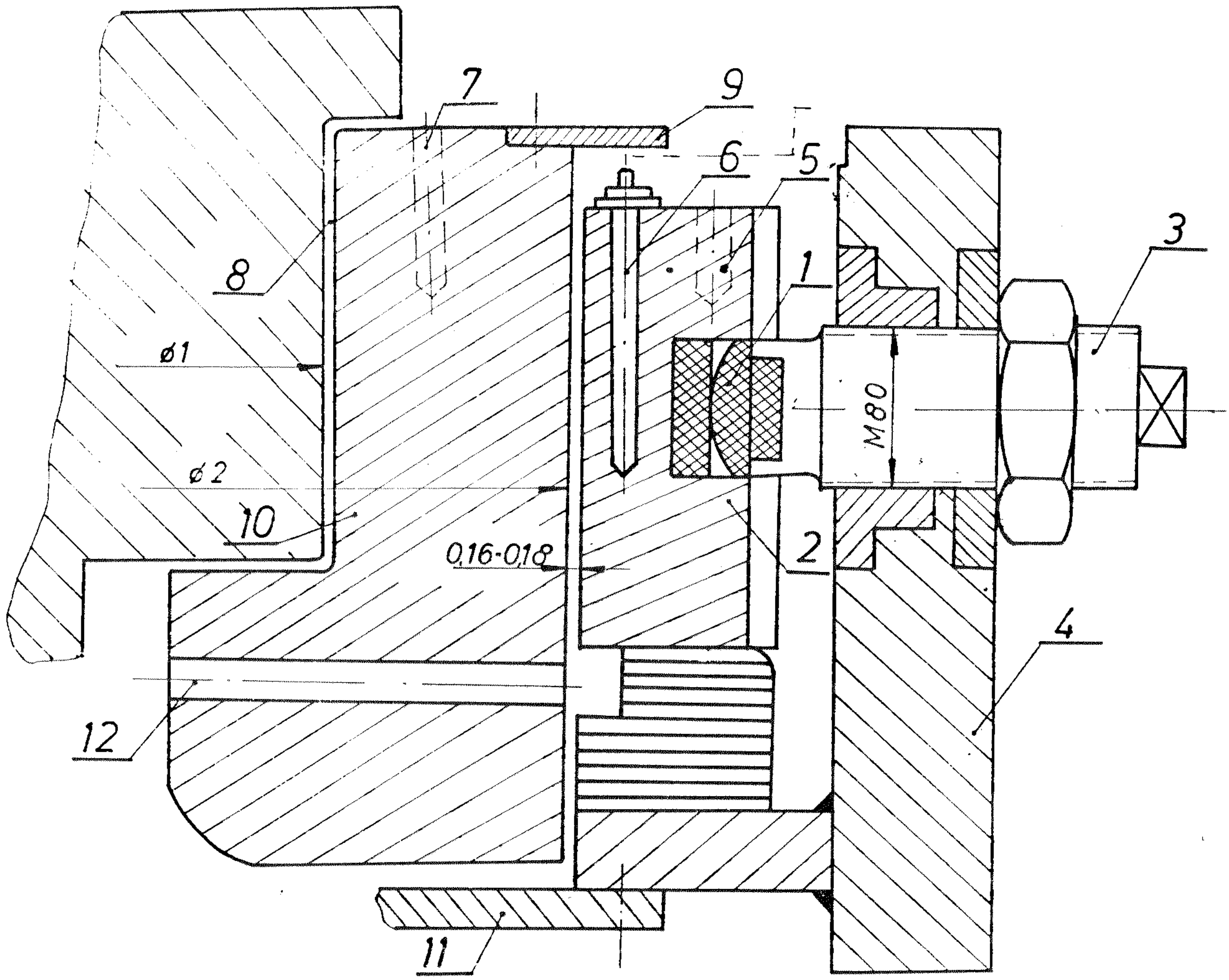


FIG 1.

BELL FORM HUB OF ELECTRIC GENERATOR SHAFT WITH BEARING

1. PIECE FOR PRESSING
2. GUIDE BEARING SEGMENT
3. TIGHTING BOLTS
4. HOLDER
5. BOLT FOR CARRYING
6. THERMOMETER
7. BOLT FOR CARRYING
8. POLIESTER
9. COVER PROTECTION
10. BELL PART
11. PROTECTION
12. VENT

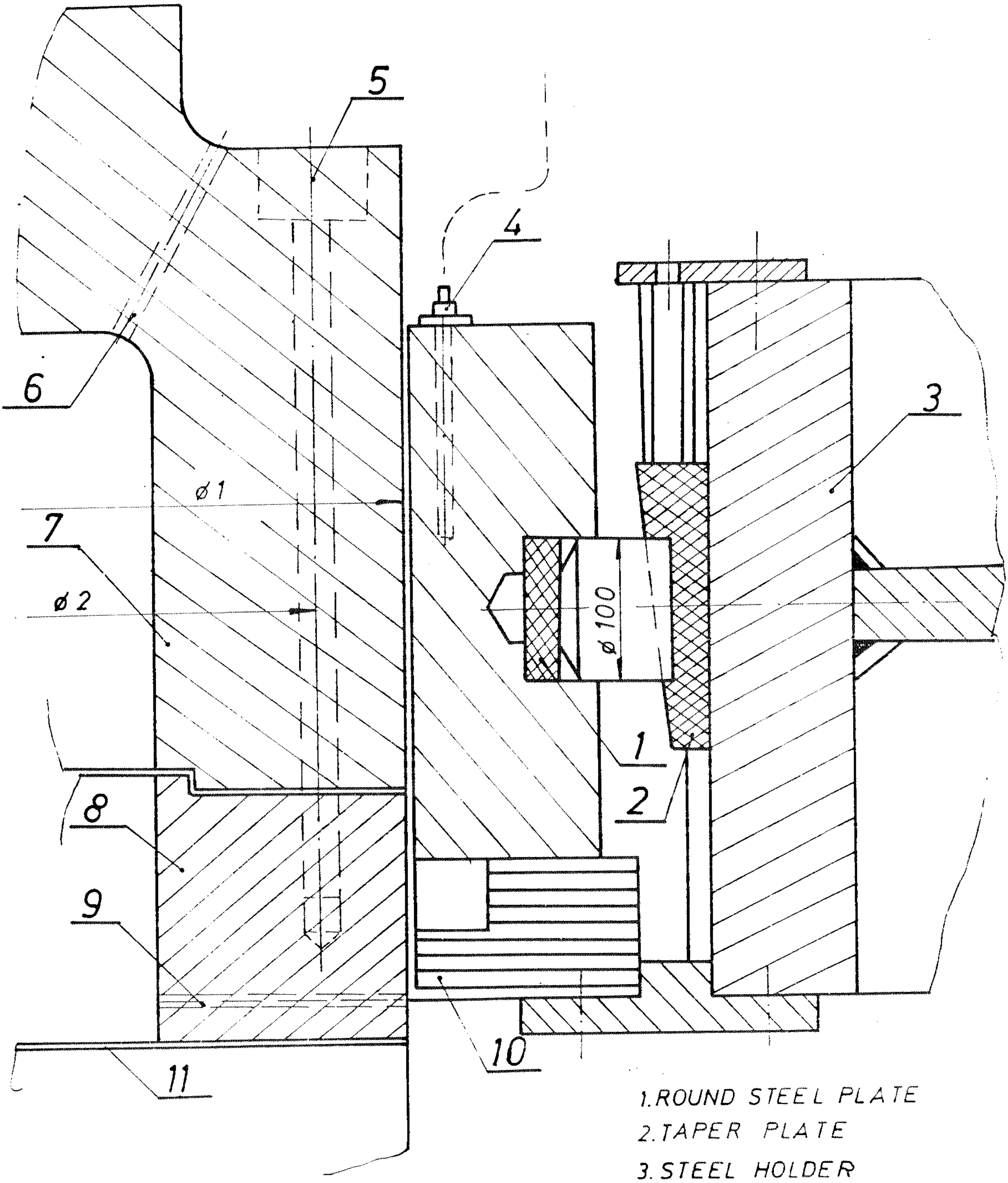
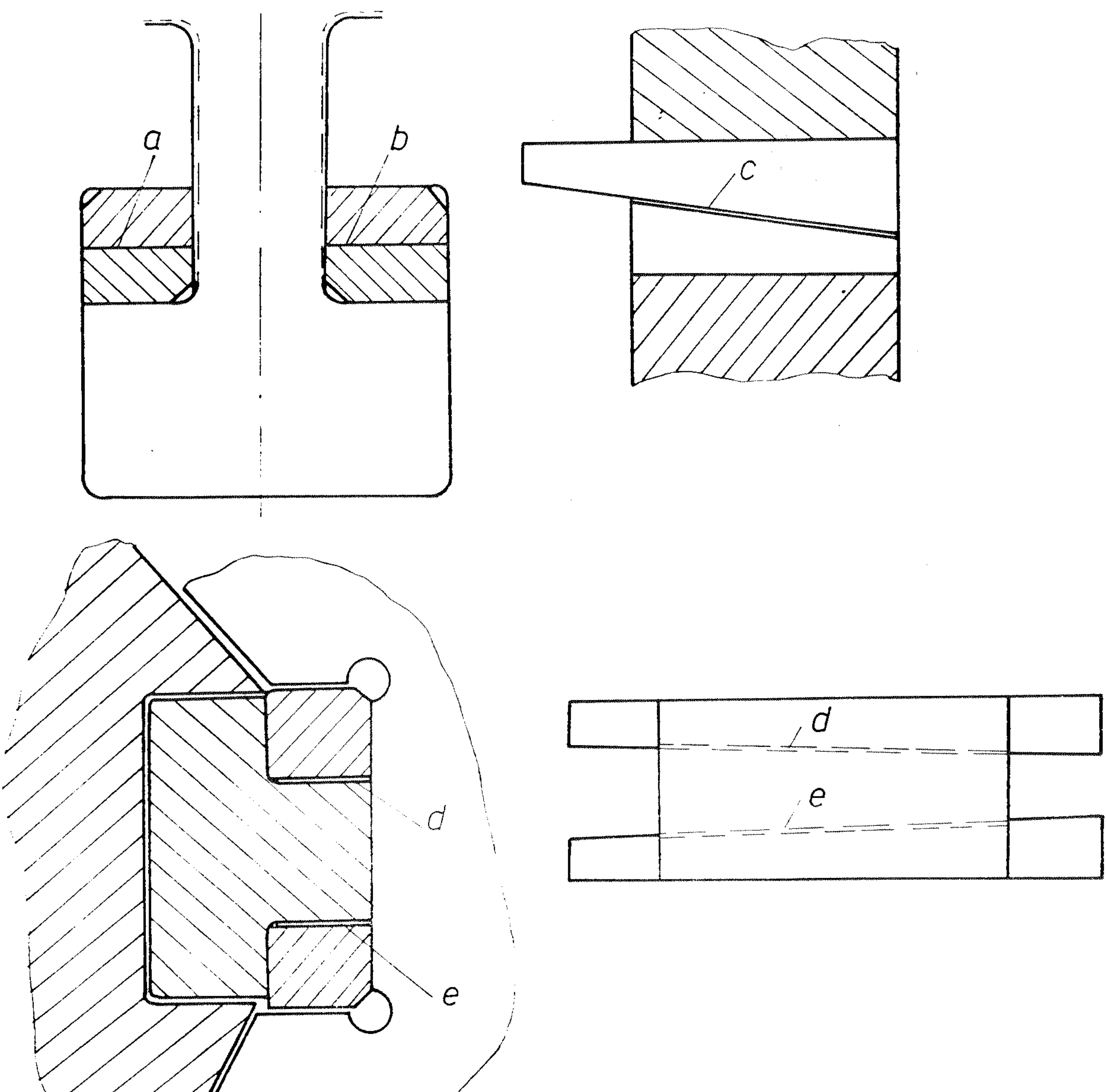


FIG.2
COMBINED BEARING
FORELECTRIC GENERATOR

1. ROUND STEEL PLATE
2. TAPER PLATE
3. STEEL HOLDER
4. THERMOMETERS
5. TIGHTING BOLTS
6. VENT
7. VERTICAL SHAFT
8. THRUST RUNNER
9. THERMOMETERS
10. GASKETS
11. LOWER-BEARING

FIG.3DIFFERENT TYPES OF WEDGES JONITS
a,b;c,d,e TIGHTING SURFACES (FRICTION)



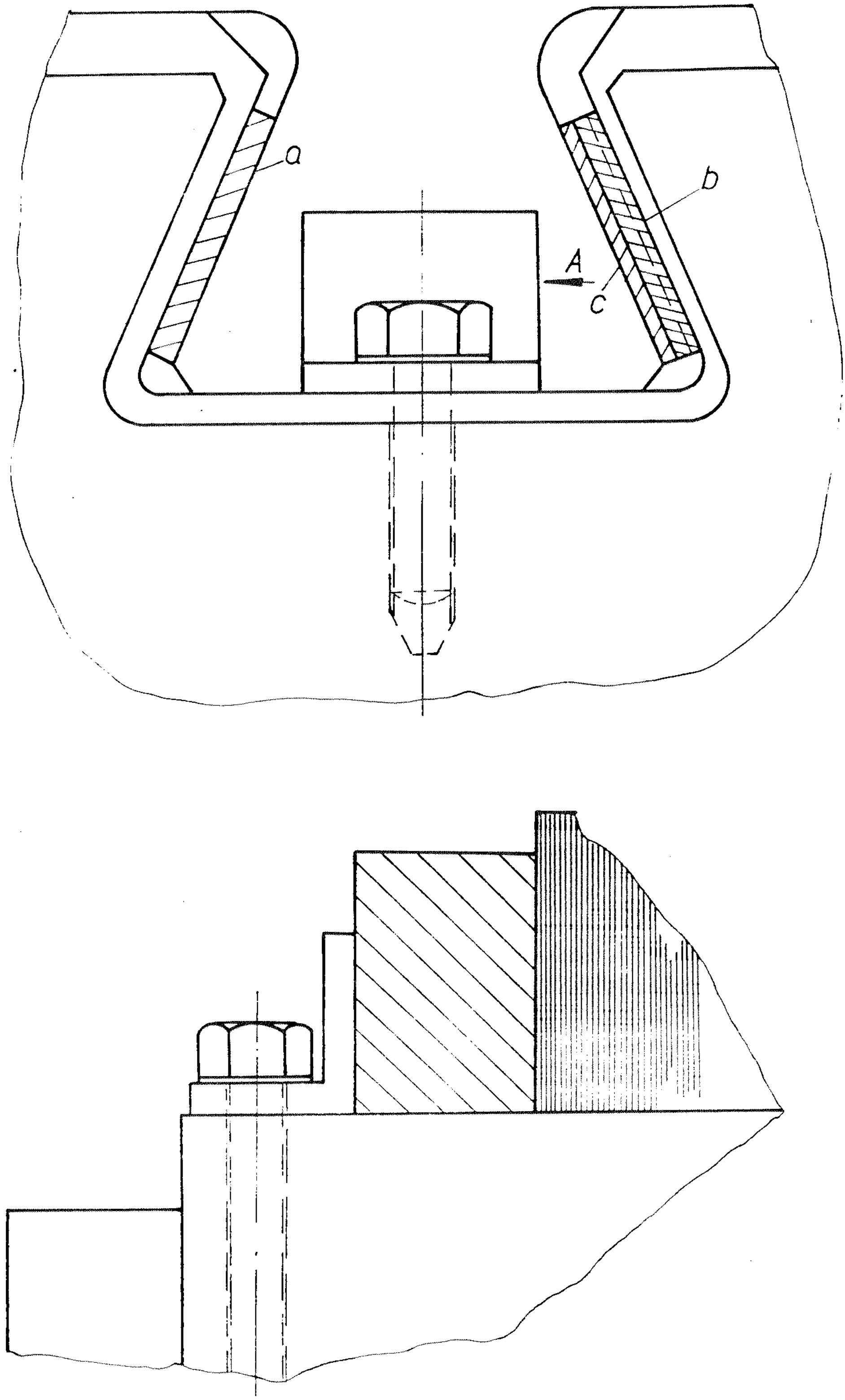


FIG. VIEW „A" INSERTED WEDGES a,b,c

1 LEVER
2 LOOSING HAMMER
3 HAND WHEEL FOR LIFT
4 CHAMBER
5 SHOCKING SHOTS
6 STEEL PLATE

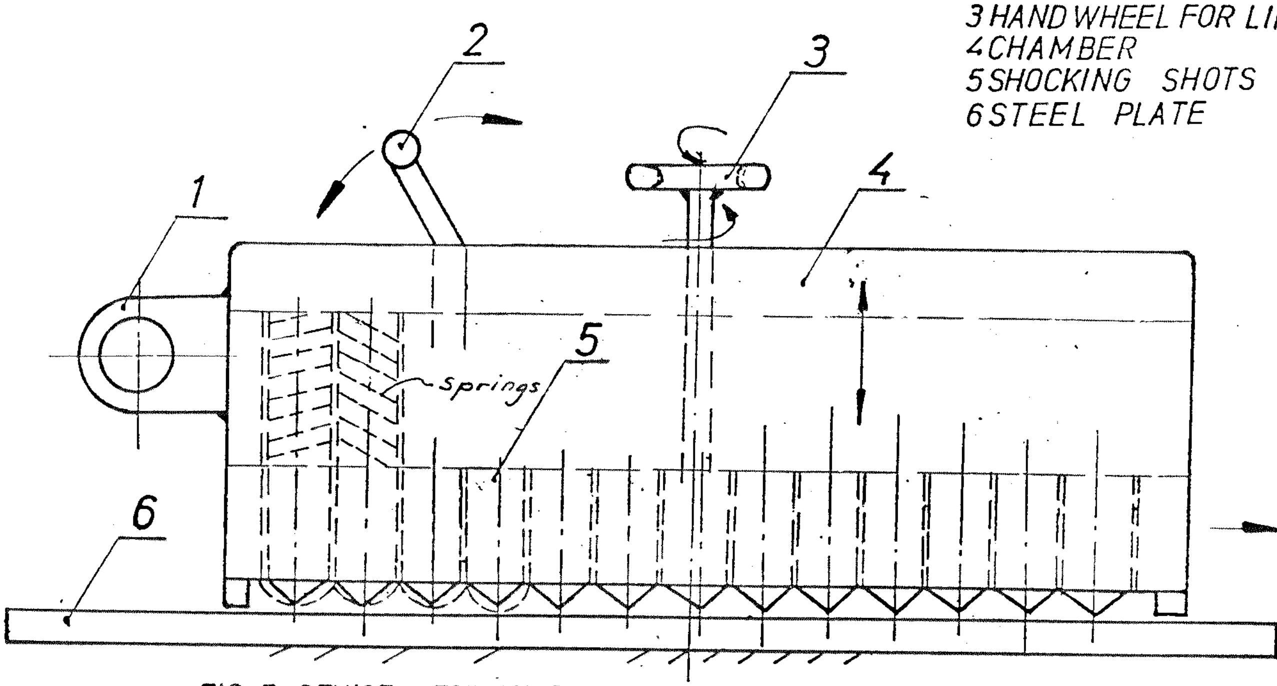


FIG.5 DEVICE FOR HARDNESS CHECKING OF METALLIC SURFACE

1 FLYING METALLIC SHOTS
2 COMPRESSED AIR
3 PISTOL
4 STEEL PLATE

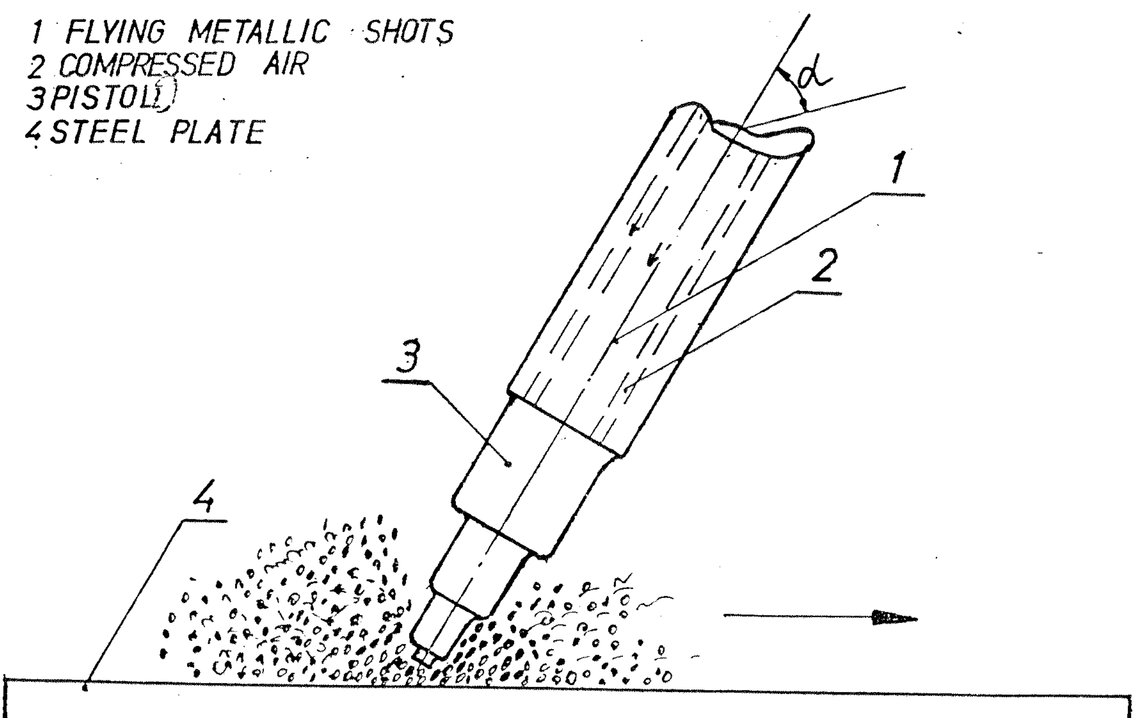


FIG.6 SHOT PEENING OF METALLIC SURFACE

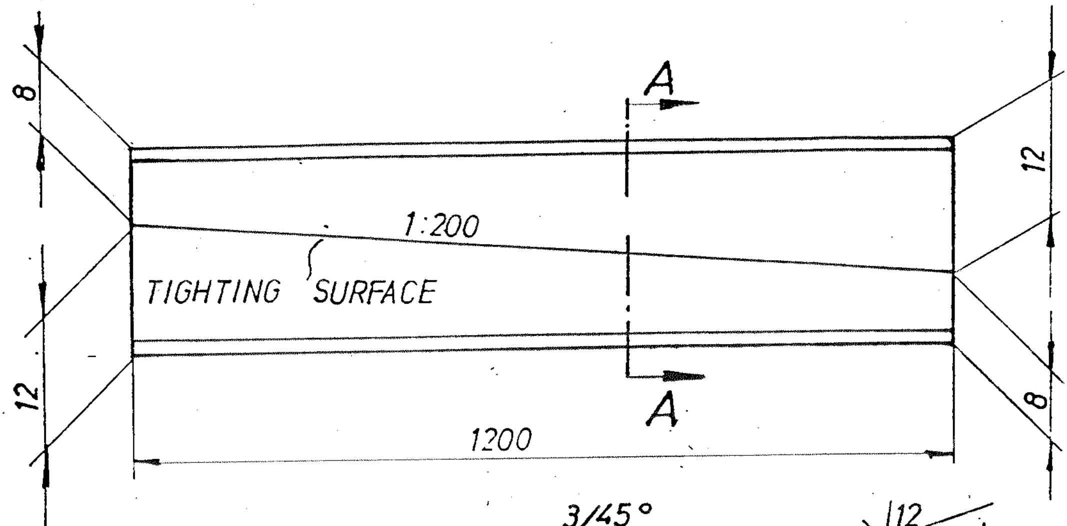
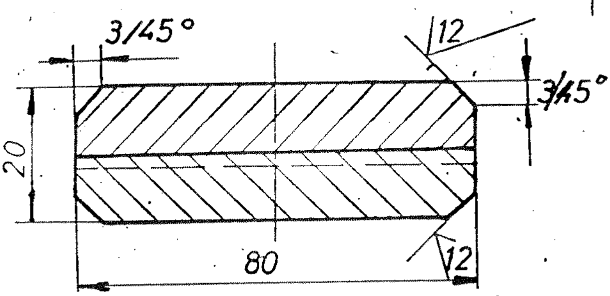


FIG.7 TYPICAL WEDGE



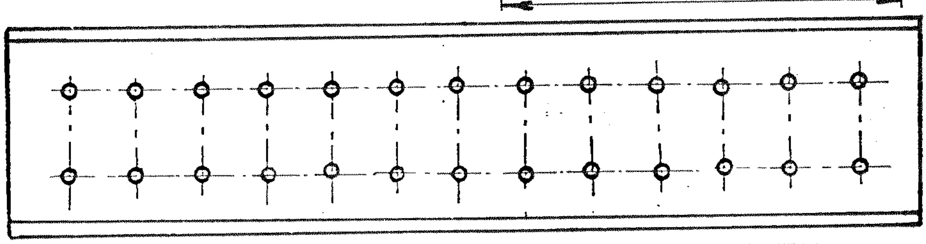
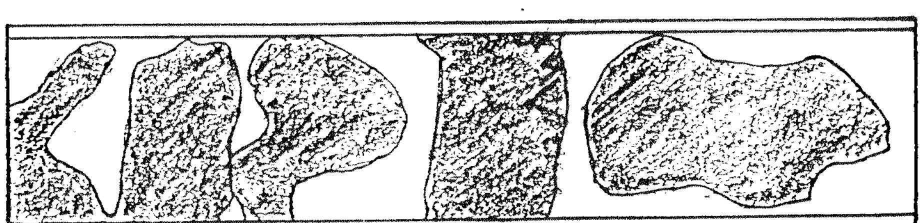
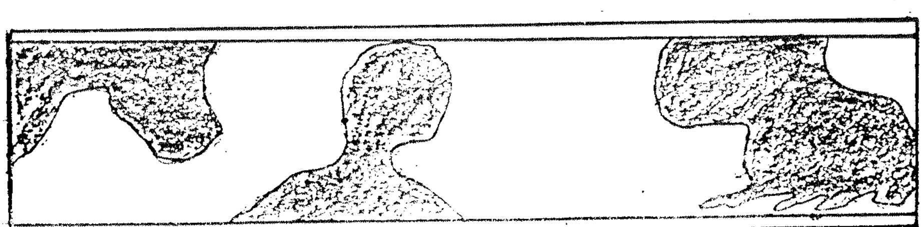


FIG.8 EQUAL HARDNESS DISPERSION AND CONFORMITY OF CHECKING ON THE TREATED SURFACE BY DEVICE (FIG.5)



a

FIG.9 CHECKING OF TIGHTING SURFACE BY PAINT



b

1. $K_i = K_p [\tan(\rho + \alpha) - \tan\rho]$ [N]

2. $K_p = b \cdot p \cdot l$ force created by pressure

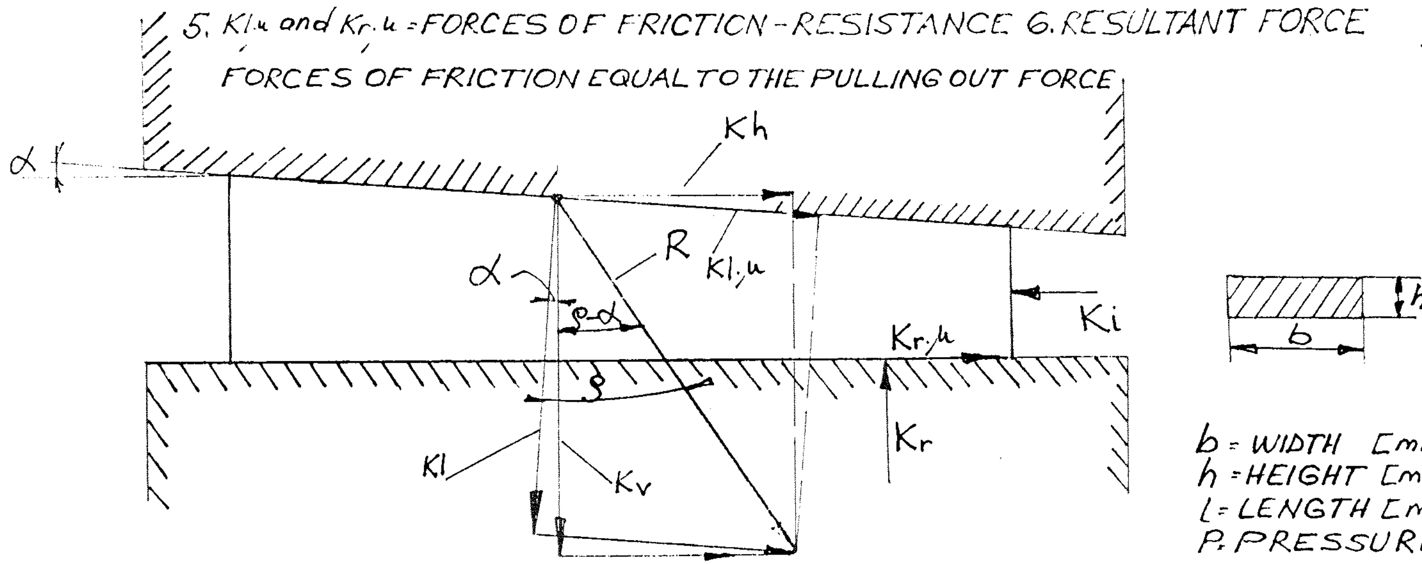
μ = coefficient of friction

3. $K_i = K_h + K_r \cdot \mu$ pushing force [N]

4. $K_b = p_b \cdot 0{,}5 h \cdot l$ lateral force [N]

5. $K_l \cdot \mu$ and $K_r \cdot \mu$ = FORCES OF FRICTION-RESISTANCE 6. RESULTANT FORCE

FORCES OF FRICTION EQUAL TO THE PULLING OUT FORCE



b = WIDTH [mm]
h = HEIGHT [mm]
l = LENGTH [mm]
P. PRESSURE [N/mm]

FIG.10. DIAGRAM OF FORCES ON THE WEDGE SURFACES DURING TIGHTING