

THE CORE OF ELECTRIC GENERATOR WHAT IS FOR SHOT PEENING?

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ABSTRACT

When is considered the construction of vertical electric generator, always is necessary to keep in mind that many heavy steel plates are continual in a moving depending of generator power. Rotor weight with water turbine standing and rotating on the not classical bearings. In the core of the generator are bearing segments - plates with effective lubricating and monitoring systems. It is provided for safe work of whole river power house. Whole stationary construction is under acting different loads. Radial and axial forces acting as well on the foundations included embedded parts. For safe work during life it is evidently that is necessary to have quality mainly steel material. That means as well to increase and to better of mechanical properties. Shot Peening surely is one method one medicine for such purposes. Rotor parts, braking rings, generator shaft in a vertical and horizontal generator are items properly cannot go in operations without Shot Peening Treatment. Numbers of revolutions of each generator to be strictly analyzed for satisfied operations.

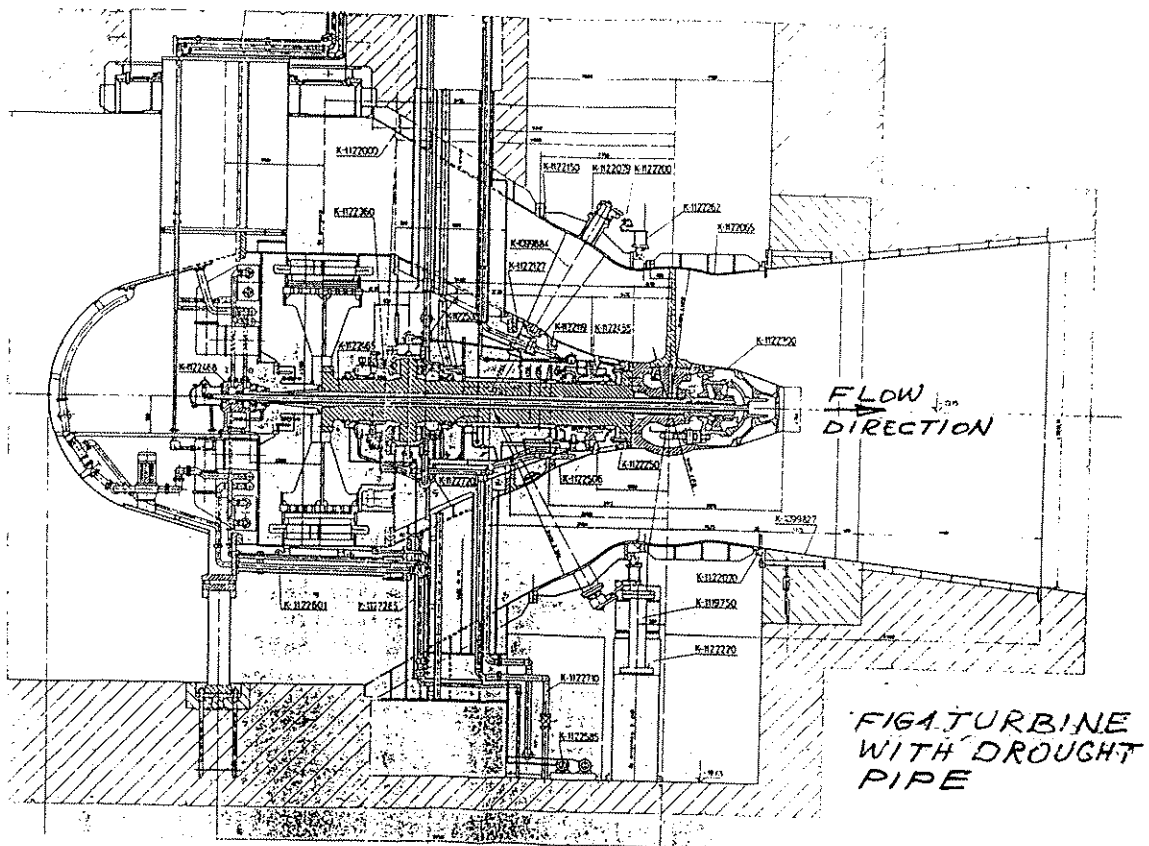
KEY WORDS:

Braking ring, Friction, Crystal, Stress Relieving, Hardness, Resistance, Lubrication, Segment plate, Hydraulic jack, Thermic dilatation, Sand blasting, Microvibration, Yield point.

INTERNAL MECHANICAL PARTS OF GENERATORS AND SHOT PEENING

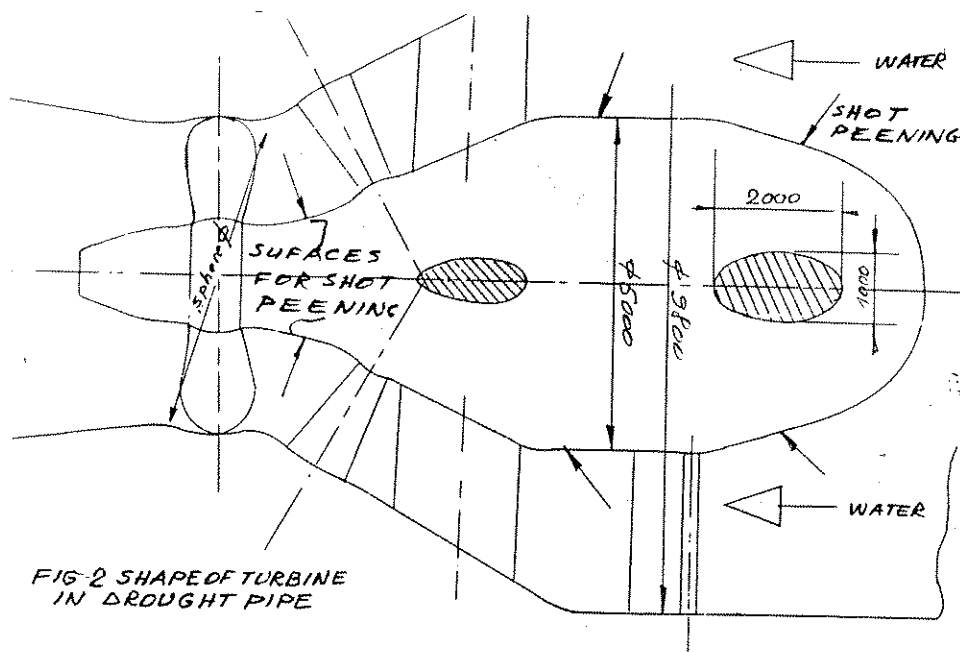
Shot Peening as one procedure for increasing of Mechanical Properties is obviously part of Whole Process of Machining - Fabrication of Metallic Items. There where is Shot Peening introduced in manufacturing Metallic Items is one thing of guarantee of quality. Education and Instruction of people in production is very important. Despite this still many companies not yet introduced Shot Peening as one Tool as one appliance in its process of production. Many of them are not informed Many of them don't follow the newest results of Scientific Recherches and Examination. Many of them don't feel necessity to change and to introduce something new in production. Their reason is the manufacturing go continual without treatment of Shot Peening. They considering so: why something add in production and prices becoming higher. Production of Electric generator properly claiming Shot Peening. Main reason to high quality and prolong operation (duration) life. Electric generator must be considered something specially. They production electric current - power for moving others plants of our daily industry. But they are not as other machine in industry. They are not as others plants working - producing continual without stopping during 24 hours. Electric current or power supply us continual. Therefore maintenance of them must follow such necessities. One factory cannot start for example without power. It is clear. Generators working continually days, weeks, months, years. Each Year going whole generator plant on the revision, reviewing, controlling following with repairing. All other machines in our industry have other schedule of work with stopping intervals. Such Schedule of electric generator is practically without such death time or intervals. On the figures 1, 2, 3 are presented the internal construction of some types electric generators. Many mechanical and electrical items placed in core of generator. In stator and rotor dominantly role have metallic part. Some insulation items serving for its function to avoiding electric current and heating caused by such resistance. Body of generators in inside one tube with flowing water (draught pipe) for moving turbine blades of rotor what is placed and fixed for housing by distant structure and bolts. The Shape of draught pipe has dimensions to enable optimal maximum flow. Water streaming

muste have one minimum resistance, because machine must arrive on the point of optimum revolution of rotor. All loads and forces pressing on the construction. Bearings take whole axial and radial forces. Forces of friction must be in allowable limits. Working surfaces of shaft and bearings must be done to have one minimum friction. System lubrication and monitoring to have in perfectly activities. Some instruments must show and give all values under allowable lines. If in one moment instruments give extra - over temperatures and pressures, whole plant immediately stopping. Automatic system also must be in action. Sliding and lubrication surfaces must be fabricated on necessary level to avoid extra forces of friction. Logi is that all surfaces such to be treated during elaboration workmanship included with Shot peening.



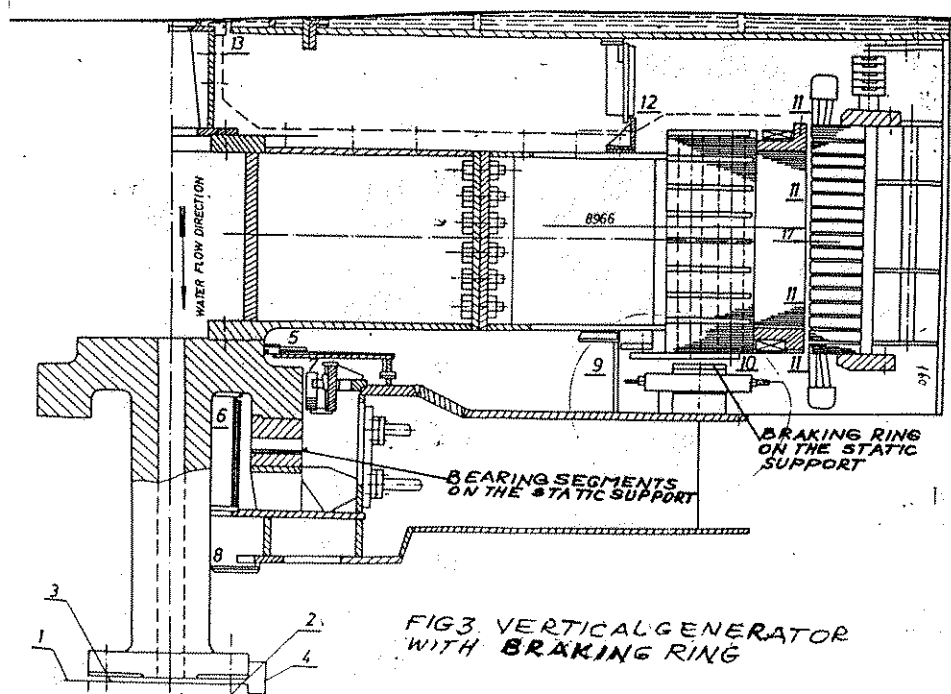
ANALYSE OF A EQUIPMENT BEFORE A START OF SHOT PEENING

During flowing of water through draught pipe the shell of generator and turbine must support loads and pressure of water. On the fig 2 we see distant girder what practically bearing a body of this machine covered with so called "pear" with complete inside placed and fixed equipment. Outside of "pear" shell must be reinforced with stiffening steel connected with concrete and embedded parts. On behind of this structure we follow change of diameter properly throat where are maximum water velocities. In this area turbine blades rotation and moving of electric generator by longitudinal horizontal shaft. On the fig. 2 water streaming around of shell and distant radial girders. Therefore here must be considered eventual appearance of very well known natural phenomenon in water. This is a cavitation. One tool against this is Shot peening. Old verity that Shot peening prevent coming of cavitation. With Shot Peening steel material becoming more resistant. In future all these areas must be considered some surfaces to be protected and reinforced by Shot peening. Some frontal parts of "pear" also be treated with this procedure to reinforce it against water forces. During annual controlling and checking all these surfaces are cleaned and repainted against corrosion. All deformations and deviation to be discovered and identities of the causes of all imperfection.



BREAKING RING NEED SHOT PEENING

Friction forces are very important for stopping work of rotor and generator. On the rotor is visible fig 3, on the bottom plate. When automatic system commence to stop rotation, hydraulic jacks lifting braking ring with plates (fig 6). In contact with down surface braking ring by pressuer and friction forces treminanting further revolution. As previously is concluded monitoring system with hibrication immediatly begining to work. It is necessary to know hydraulic jacks arranged around whole rotor bottom plate depending of the power generator. Depending of a power minimum hydraulic jacks can be four (4). They lifting and lowering in the some time. Upper surfaces of these plates must have surface hardness to resist the forces of friction.



On the figure 3 we see internal structure of vertical generator. There are main shaft connected with shaft of Kaplan turbine. On this figure we see mobile - Rotor parts and stator parts with insulations. Below rotating parts is on fixed supports around staying braking rings with surfaces of plates (see fig. 6). This braking rings with plates serving for braking of generator. Direction of waterflow is vertical and big masses of water dropping on the turbine blades during work. When is stoping of work this braking ring should help to stop of rotation of rotor. Hydraulic pumps lifting ring plates to press bottom plates of rotor by friction. This friction lifting heating and temperatures. But all these heating must be in allowed values. If is something over permitted number immediate start lubrication system. Of course all these plates to be Shot peened.



FIG.4B CHAMBER FOR SHOT PEENING

FIG.4A FURNACE FOR HEATING



On the figures 4 a and b presented something very important for Shot peening procedure. On the fig 4 a is chamber for treating some huge metallic parts. People inside working protected with adequate dress. He can see where is necessary to blast some metallic surfaces. Fig 4 b is inside of industrial furnace for heating metallic parts as stress relieving. Automatic furnace with mobile platform going in with some metallic items. It is very important during investigation some procedure Shot peening, heating after welding, sand blasting etc.

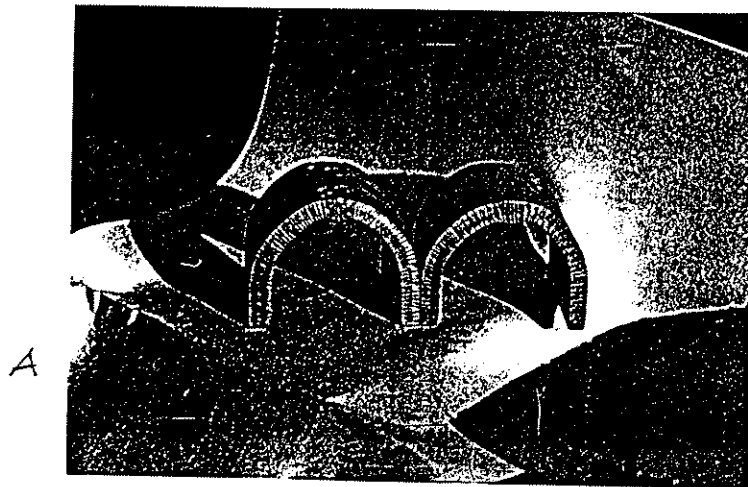
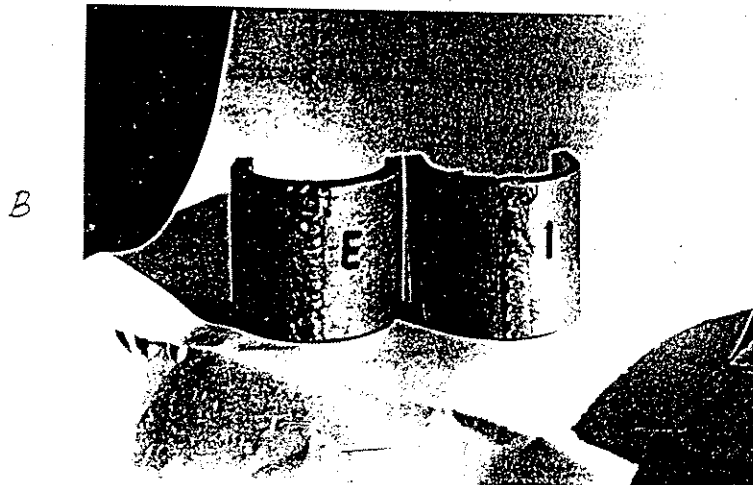


FIG. 5 PLATE „E” ONLY WELDED WITH CRACKING
PLATE „I” WELDED AND SHOT PEENED WITHOUT
CRACKING AFTER BENDING (AWS, API, ASMES-D)



As material taken for light generator normal usual carbon steel, for braking ring. Surely for generator of huge load of rotor necessary for braking ring to take some specific special steel regarding mechanical properties. Of course that Yield point, tension stresses, allowable stresses etc. are higher for steel plates treated by Shot Peening what is visible on the figures 5 picture "E" and "I". Shot peening increase mechanical properties, because cracking is on the plate without Shot peening. On this way testing pieces with welds are prepared (fig. 7). Difference between these two plates showing us that Shot peening increase stresses for final break of plates Testing with samples (fig. 8). Show the testing on the bending in accordance with usual rules from praxis (AWS, API, ASME S.IX)

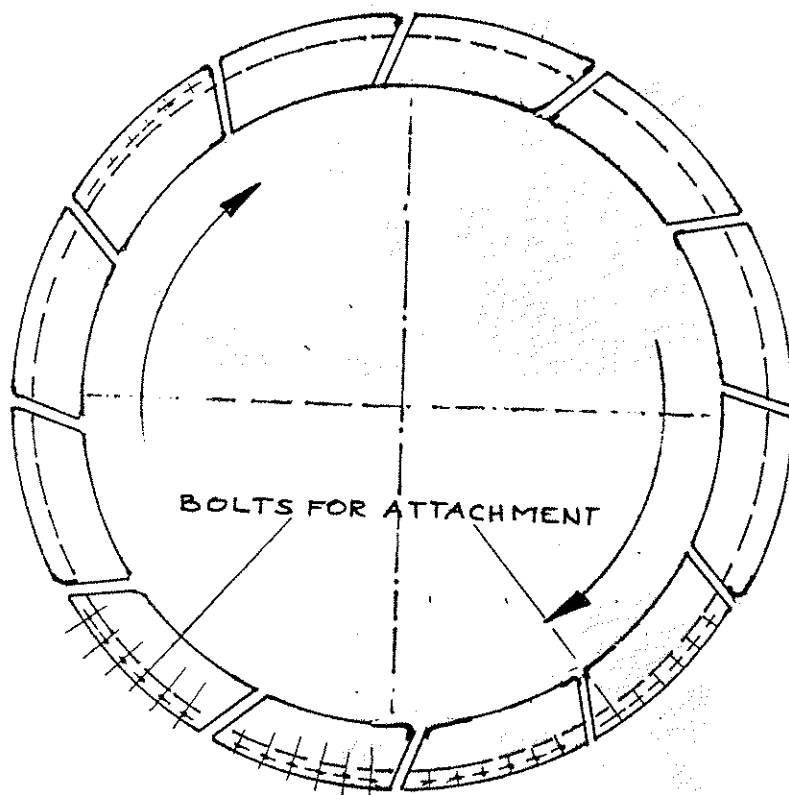


FIG. 6 BRAKING RING FOR STOPPING OF ROTATION OF ELECTRIC GENERATOR

During all these examination internal structures of crystals changing position. Crystals must remain in its natural in one equilibrium in free position. Fig 9. show us these treated and not treated material crystal structures. That is very important to see before further investigation. During Shot peening we know that compressive stresses in surfaces becoming higher. Measurements of residual stresses vary depending of depth. From surface to internal layers these stresses decreasing. On the figure 9 is indicated some points where is checked semimicrohardness with special machines. Of course such diagrams stresses connected with hardness give whole families of diagrams and showing beneficial acting of Shot peening.

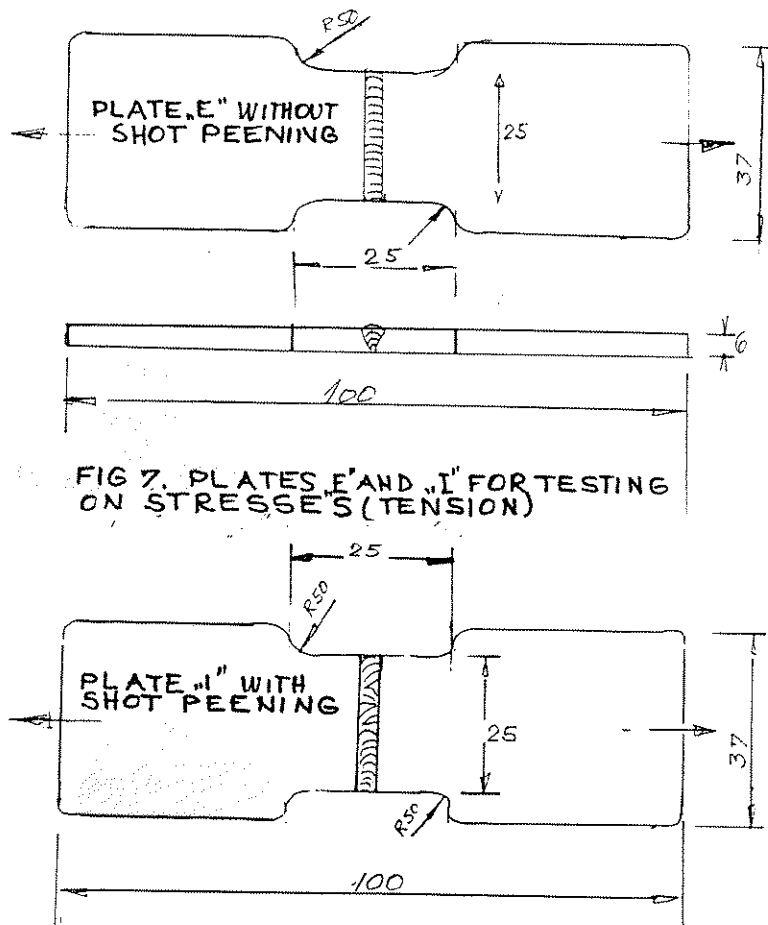
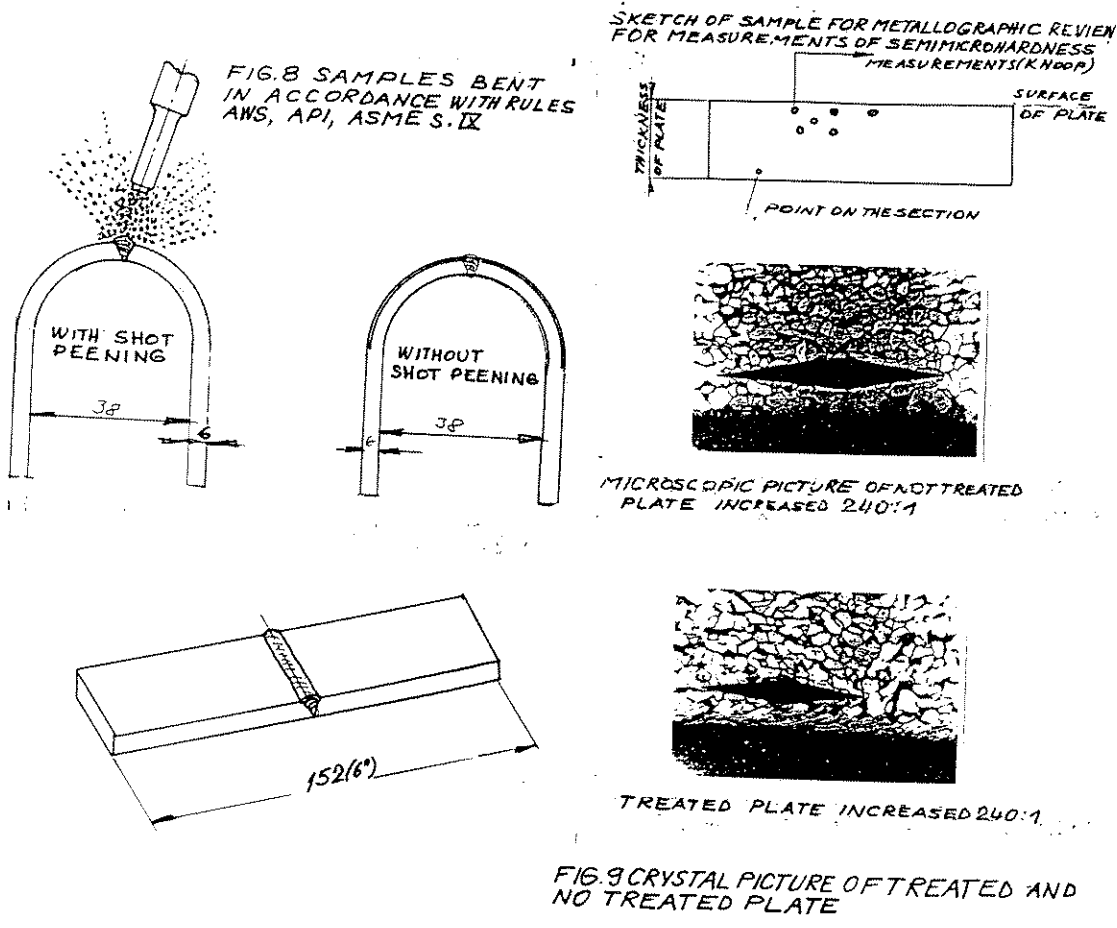


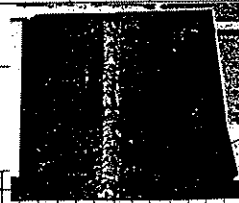
Fig. 10 presents something small of large research some over 20 twenty pieces of samples what was treated by method of microvibration. These taken plates have been treated. On the picture is one black photo of this steel plate, Dimensions 100x100x6 with diagramming and measurements values what was shown - frequency, power electric currenxy. Old science and knowledge say us that one steel or any other metallic piece under vibration making one internal equilibrium in structure in crystals. One item treated on this way we freely can confirm becoming with more internal harmony. Crystal inside staying in one more equilibrium. This big theory and not space here to present. Only we can conclude, that electric power (electric currenxy indicated) in table has les resistance what show on the fig. 10 as amperage (A).



Microvibration decreasing residual stresses in material. Apart this external impacts, shocks or internal deformation caused by welding and some bending causing some residual stresses. They cannot remain in such material. They can cause disaster - braking of constructioc +n. Full elimination of residual remained stresses theoretically is not possible. But some percentage can be decreased what is very important. Some companies using method of vibration as unic way for steel items in their production (Morgan Steel Cinstruc. Com. Worcester - Massachusetts - USA). Fig. 10 shows such intention decreasing internal resistance and electric currency for some frequency.

1. MEASUREMENT			2. MEASUREMENT			Δ I (A)	Δ I (%)
FREQUENCY (min ⁻¹)	CURR. I (A)	CURR. II (A)	FREQUENCY (min ⁻¹)	CURR. I (A)	CURR. II (A)		
1300	1,4	1,35	1300	1,3	1,28		
1600	1,5	1,45	1600	1,4	1,35		
1700	1,6	1,52	1700	1,5	1,45		
2000	2,2	2,15	2000	2,10	2,08		
2200	2,20	2,18	2200	2,1	2,05		
2500	2,00	1,95	2500	1,90	1,88		
2800	2,00	1,95	2800	2,00	1,9		
3500	2,30	2,28	3500	2,20	2,15		
							Σ Δ I =

DIAGRAMMING



STEEL PLATE WITH WELD

KONČAR Elektroindustrija
 Tvornica generatora
 Zagreb - Fušterova željezite 22

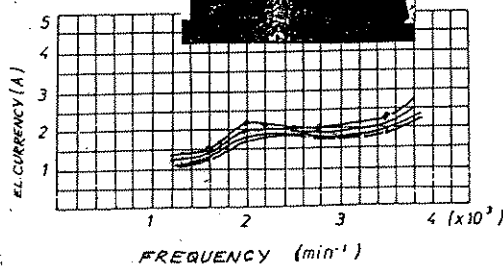


FIG.10. TREATMENT OF WELDED PLATE WITH WELD BY VIBRATIONS

DISCUSSION AND CONCLUSION

Braking ring plates during generator should be in quiete position because no tauching no kontakt with upper plate of rotor. It is necessary to keep in mind that in this area below rotating items of rotor temperature is little higher continual. Sistem monitoring with instrument-sensors-thermometers to be function connected with system of lubrication of bearing segment. All misfunction to be immediately evidented. All is function good and continual operation. Braking ring must reinforced and protected against fatigue and enhancement stress corrosion. Between others procedures to reach this aim is Shot Peening. It is one betterment method for general conditions of all rotating items in rotor and stator complex of one horizontal or vertical electric generator. Mny appearances in nature are followed with certain degree of Shot Peening. What is sometimes is very useful and beneficial. On this way should be considered problem of elimination or pcentage degree decreasing residual stresses in a internal structure of crystals. Some manufacturer in metallic industry using for equilibration internal structure method of heat treatment, some using method of microvibrations, etc. Some people during designing supports for piping systems for liguid and pipelines create small useful vibration, what more useful than any other method (Heat Treatment) and beneficial for equilibration of internal layers and crystals. If we have internal equilibration on without pressure and tension - these famouse residual forces, stresses and pressures will on the degree - not causing braking, disaster - catastrophic dangeraus for big structures. Therefore status or pictures position of crystals must be before further research konown. Fig. 9 shows crystal position. If is something deformed it is useless follow further research with such structure. Perhaps thermic (furnace fig. 4 a) treatment is necessary to decrease internal tensions and positions between crystals. Therefore complete research of such problem is necessary to take more samples plates. It is necessary to take more testings to have true picture. Sand blasting using for removing somedirties to have cleaning surfaces for further procedures and researches. But sand blasting in some cases is beneficial for equilibration of internal crystal structures and partial or total elimination of RESIDUAL STRESSES. These internal tensions can be caused of one different external factors. In our mechanical praxis we thniking about welding, rolling, bending, impacting or some others deformations. Therefore on the plates of our braking ring of vertical electric generator we have

taken 24 samples with all testing and analyses. I have gotten results and curves of microhardness for different depths and photos of all 24 plates. Some cases microvibration is more beneficial than other method but it is special case. When is useful and possible to do such procedure. Shot Peening of some plates with welds is clearly supreme regarding diminishing residual stresses and increment of mechanical properties (fig. 5, 7,9). Always our departing for research must be established on the already know mechanical requirements and chemical composition. Shot Peening is important for additional benefit of enhanced resistance to fatigue and corrosion and achievement fatigue life enhancement. It as well inhibits stress corrosion cracking. I like to express my big thanks Prof. Dr. Štular P. from the Technical University Ljubljana Slovenia for many useful advices. As well thanks going to Electrotechnical Institute Končar Zagreb Croatia for assistance and use of their Laboratory for mechanical testing and research.

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