DII-8 Existence of a Defect and Its Influence Upon Mechanical Properties

Yukichi Asakawa*

1. General introduction

The author has before years [1] studied some relations between a defect and its influence upon mechanical properties. The present author takes the state of a material which is subjected to the repeated impact test shown in Fig. 1 as a defect. Then, the defect thus occurred locally in the specimen may in the wide meaning be supposed to be a "macro-dislocation" if the section of the specimen be regarded as an object of study. For the sake of taking this defect into consideration, the specimen is taken off from the repeated impact machine before its final rupture and then, Charpy single impact test is applied to the same specimen. The form of Charpy test piece is shown in Fig. 2; the direction of the blow of Charpy hammer is so arranged as to coincide with the one of the previous impact blow.

2. Some experimental results

(A) In the case of 0.1% C steel

In this case, the mean number of reversals up to rupture in the repeated impact test is known to be 1900. Specimens are first subjected to the repeated impact blow of various numbers of reversal respectively under 1900 reversals, and then tested by Charpy machine. The results thus obtained are shown in diagram (a) in Fig. 3. Seeing this diagram, it is known that the specimens which were subjected to blows amounting to 2/3 of the reversals up to rupture do really receive no influence upon their own Charpy values. This is really worthy of being specially pointed out. Namely, this fact may indeed be taken as an aspect of the behaviour of a material which is subjected to a local defect. But, even in this case if these specimens were heated at 100°C far

* Nihon University College of Science and Technology, Surugadai 1-8, Tokyo (Japan)

blow their recrystallization temperature, then, there do clearly occur decisive changes between themselves. Namely, diagram (b) in the same figure gives us the effect of 100°C heating. Seeing this diagram, it is known that the specimens which were subjected to 400, 800, 1200, 1400 reversals of blow do really show each a remarkable decrease of Charpy value. The full explanation of these results was given in another paper [2]; here, it may suffice to point out that these changes of Charpy figure are nothing but an outcome of the stability of a state of the cold working, namely,"macro-dislocation". The effect of 200°, 300°C heating is also shown respectively in the diagrams of (c), (d) in the same figure. Now, if we rewrite these results as the effect of heating temperature, then, Fig.4 may be obtained. Seeing this figure, we may easily point out a clear idea of the effect of heating. Here, as the résumé, it may be suggested that a defect, if it be locally occurred, does in some instances give no influence upon Charpy value; but, if there be heated at 100°, 200°, 300°C far below recrystallization temperature, there does really occur a remarkable decrease of Charpy value amounting to 1/60 - 1/80.

(B) In the case of Brass

In this case, the mean number of reversals of blow up to rupture in the repeated impact test as above is also 1900. The effect of blow of various numbers of reversal given in the repeated impact test before rupture does in this case show in itself each considerable difference between Charpy values, contrary to the case of 0.1% C steel. Fig.5 shows these results. However, these results may usually be supposed to occur. The discrepancy between these two materials may naturally be attributed to the difference of the behaviour which reveals in itself in the mechanical properties. The effect of heating far below recrystallization temperature is also shown in Fig.6; the results of which are at first appearance seen somewhat to be complicated. But, if we examine these results only about the change of Charpy value, there may be seen to exist a general tendency between themselves. Namely, when the

number of blows is small, the effect of 100° heating does show decrease in Charpy value; when the number of blows is large, the effect of the heating does always show an increase in Charpy value.

3. Conclusion

The author paid attention to the effect of a local part which may be suffered by the blows as in the repeated bending impact test, and regarded this local part of a material as "macro-dislocation". The results obtained may certainly afford some new ideas to the general consideration of the constitution of mechanical properties.

References

(1) Jour. Mech. Eng. (Japan) 33, 300-317 (1930); (2) ditto.

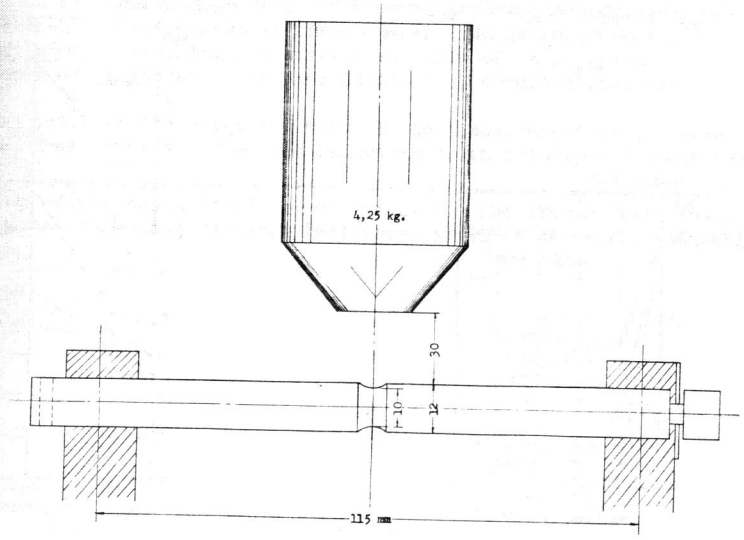

Fig. 1 Repeated impact tester

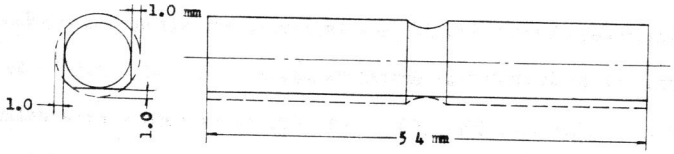

Fig. 2 Charpy test piece

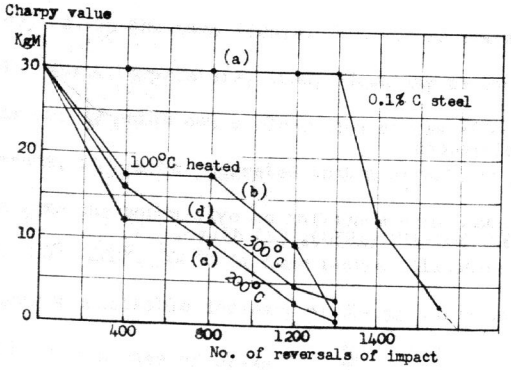

Fig. 3

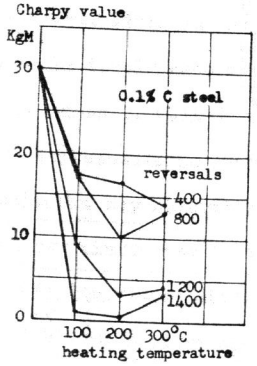

Fig. 4

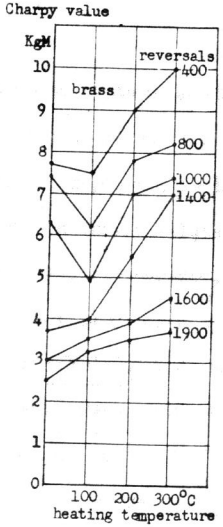

Fig. 5