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SDC
SOLENOIDAL DETECTOR NOTES

SDC MUON BARREL TOROID

POSSIBLE IMPROVEMENTS FOR THE MBT DESIGN FOR EASIER & FASTER ASSEMBLY

July 1992

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Introduction

In this report I tried to lay-out my views on the construction of the toroid. Working on the scale model allowed me to notice possible problems that may be encountered in the construction of the SDC magnet. Upon analyzing the existing design from the point-of-view of basic principles of steel structural construction, I tried to find a method of assembly that would help in avoiding some of the problems existing in the present configuration. Below I give well known principles that I try to follow in my practice:

-Any design must combine simplicity of fabrication with good quality control, ease of assembly, and of use, and also, in the case of large structures, ease of transport. Total cost includes the expenses at each of the project stages. It is possible to save on one stage, and lose on the total, and vice versa.

-The design must consider loads that will exist during assembly. Loads must be carried by the shortest load-path. The fewer elements on the path, the easier the assembly.

-The assembly must contain the smallest number of parts. Each additional complication must give a positive contribution, and facilitate the total construction while reducing costs.

Basing myself on these principles, I tried to visualize an ideal construction of the toroid, that could be assembled in a short time, with the required quality and at minimum expenses.

Design influence on assembly

The basic stage in the fabrication, where time and money could be saved is the final assembly of the magnet. It would be very advantageous to conduct it without the use of auxiliary support structures. In this case, the magnet blocks should be located and installed directly by the crane, with automatic latching into place. This requires a different coupling of the blocks into the ring, taking into account the loads of the partial assembly. Since these loads do

not change direction, this coupling can consist of two interlocking hooks (Fig.1,2,3). With a thickness of 1.5 m for the toroid wall, there is ample room for a reliable coupling system. It will adequately support both the bending moment and the vertical forces.

It will also be beneficial to eliminate the plates tying the rings in the axial direction. For this it is sufficient to shift the blocks axially by half their thickness, and tie each pair of neighboring blocks in the axial direction by means of keys.

Adoption of this technique for joining the blocks will considerably speed-up and facilitate assembly. The crane will install each block in place, with automatic latching and no manual fastening in place. A monolithic, rigid structure will be obtained immediately upon installation.

Blocks fabrication

Fabrication costs can be reduced by eliminating joining steel plates into blocks by bolting and pinning, and using arc-welding instead. This option is desirable for a facility like Izhora, as they have a good welding capability. In addition, the magnetic field uniformity will be improved, since the volume of the welds is smaller than that of the bolts and pins, and in a better orientation, with no air-spaces due to bolt clearance requirements.

Blocks inspection

Inspection costs may also be decreased by removing the requirement for checking ring-fit by trial assembly. This is worth considering for several reasons. First, this is not compatible with the planned toroid assembly sequence: The lower blocks will be used first, in the on-site assembly, but each will require a finished, fitted ring, whose parts will have to be stored. Second, it is difficult to assess the dimensions of a ring of this size. The optional horizontal trial assembly will not introduce the final assembly loads, and ignores the difficulty of close-fitting heavy blocks resting on a frictional, horizontal surface. Finally, to select the

blocks for a test-ring assembly, information may be required on all the blocks.

In my opinion, instead of these trial assemblies, it is sufficient to conduct a careful inspection of each block, utilizing a specially prepared inspection installation. This could consist of the following:

-one ring is fabricated and tested for assembly.

-a test stand is built for each block type, with special fitting provisions replacing the fitting adjacent blocks.

-each stand is calibrated with one of the control blocks (Fig 4)

-each newly fabricated block is measured on the corresponding stand, to evaluate its fitting into its ring at assembly (Fig 5)

In this arrangement, the keys that lock the blocks into the assembly do not undergo a strict control, only the location of the milled key-slots. During the final assembly (at the SSC), the tolerance accumulation between the slots of adjacent blocks (as reflected by the distance between them) is used to define the proper offset of the corresponding key, and matched by milling it to make an acceptable axial match, ring-to-ring (Fig 6).

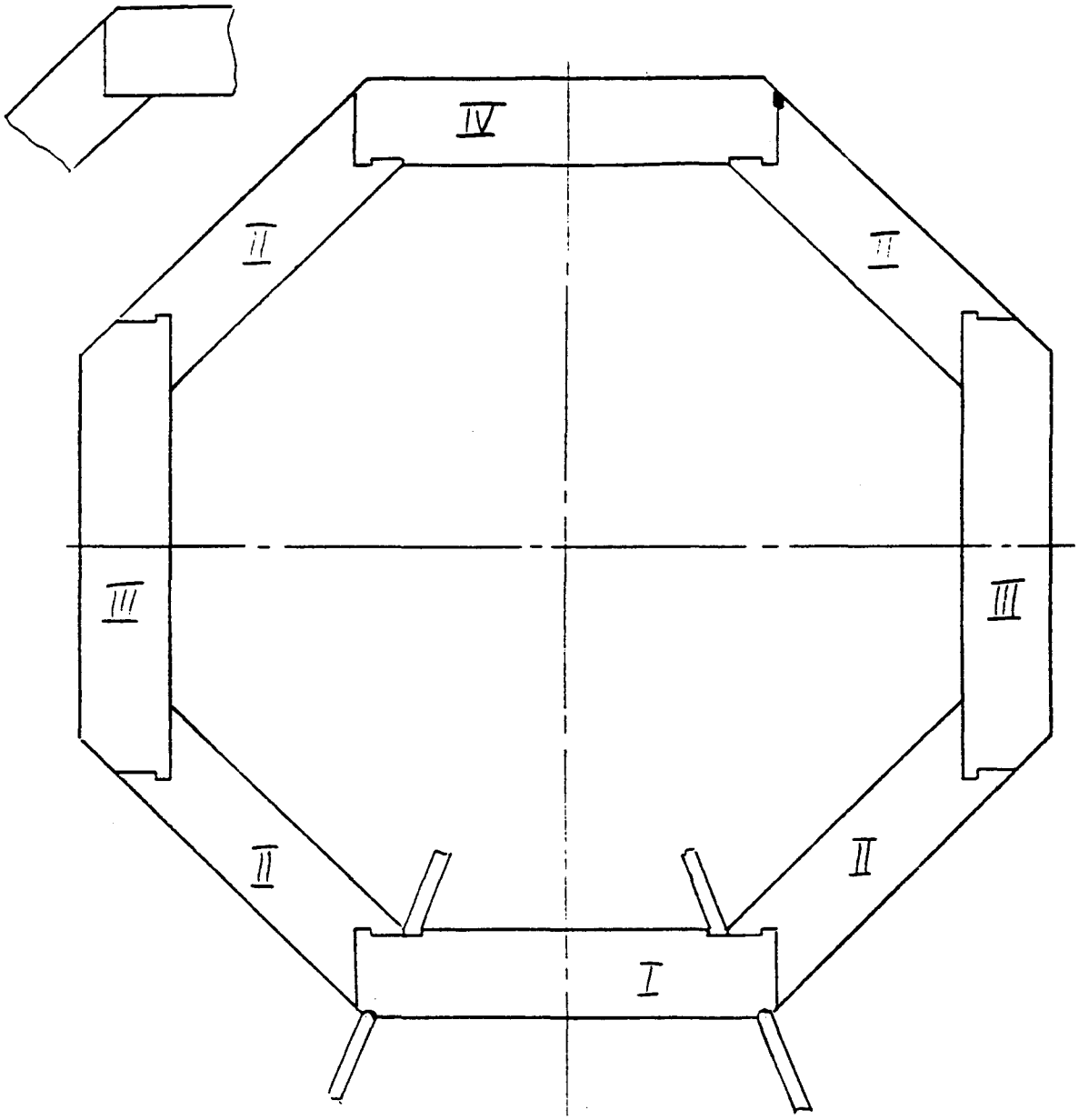

Fig. 1

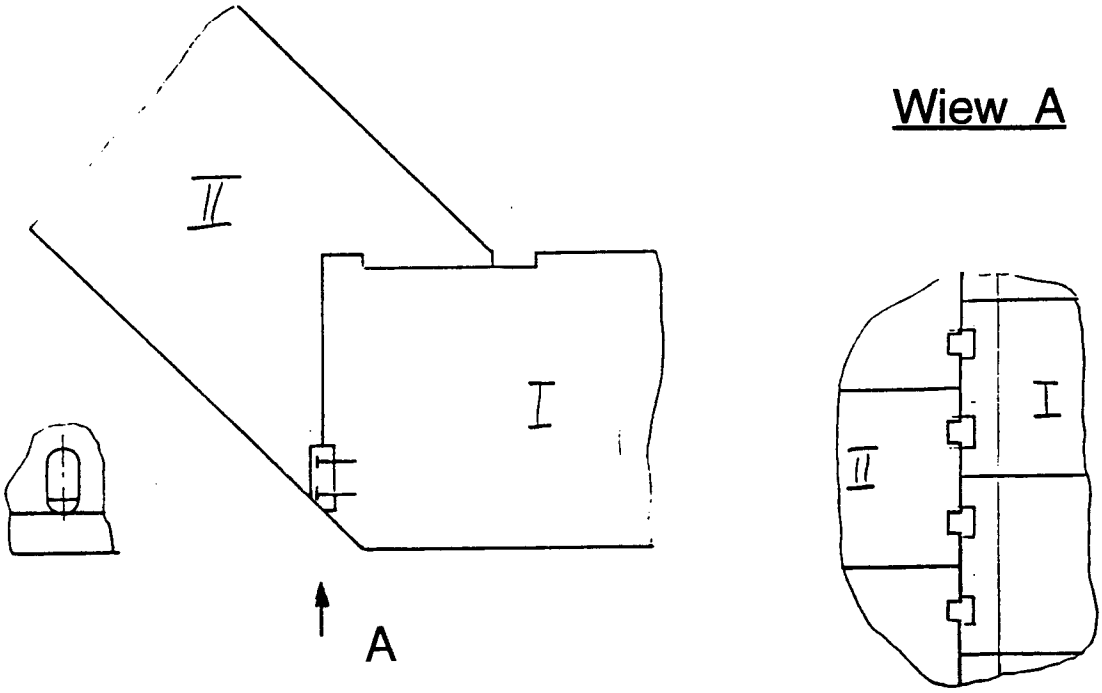

Fig. 2

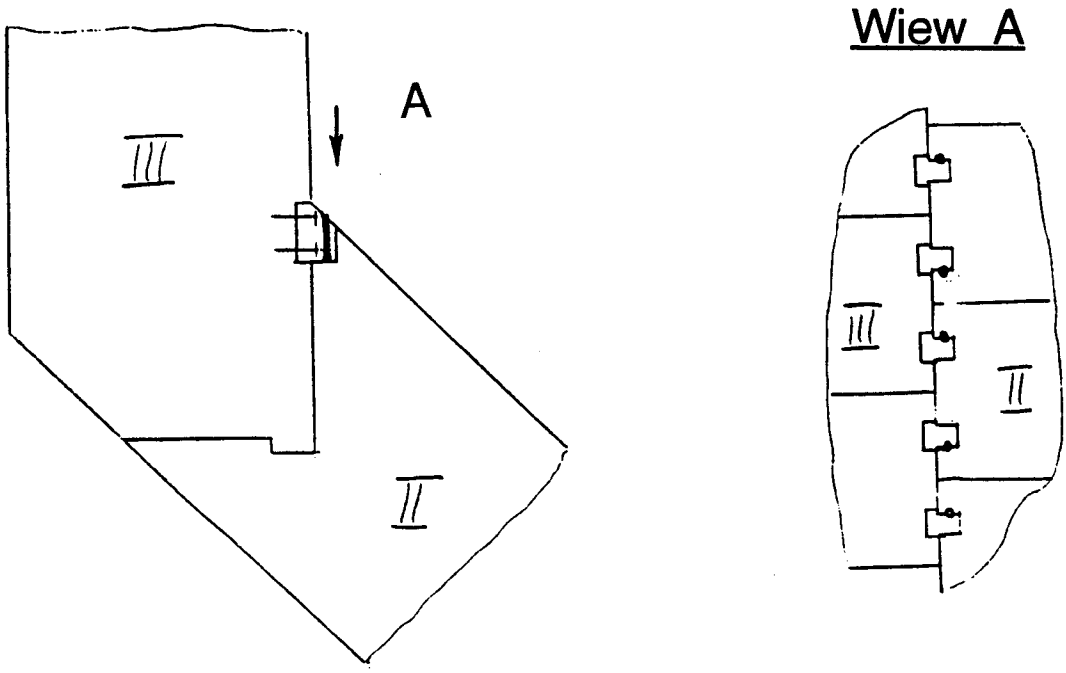

Fig. 3

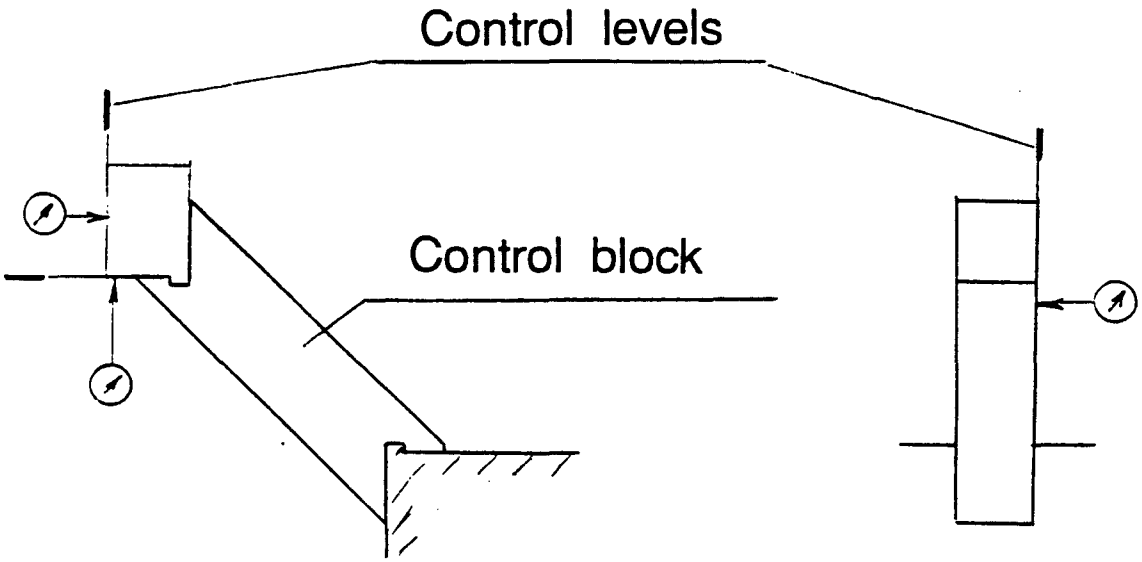
Control levels
Control block

Fig. 4

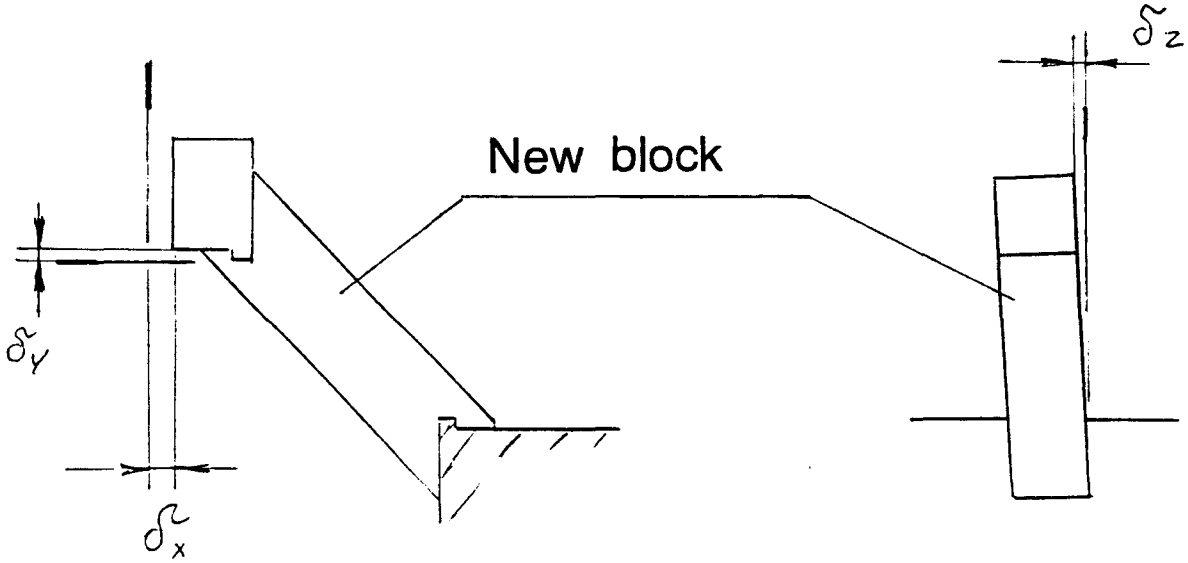
New block
δ_z
δ_y
δ_x

Fig. 5

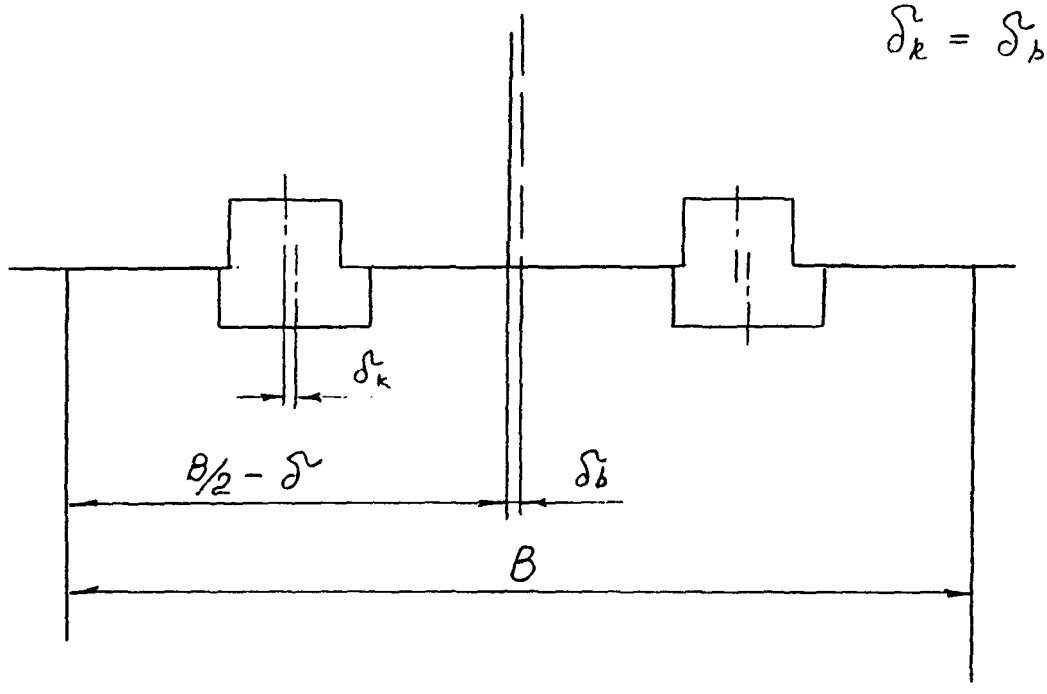

Fig. 6