A POSSIBLE IMPROVEMENT ON TRACK DETECTION BY VARIATION OF THE SLIT LENGTH

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To date,all Spiral Readers operate with a slit of fixed dimensions. It may be replaced by another of different dimensions, yet its length cannot be altered during the periscope movement.

The slit should fulfil two contradictory requirements:-

i) In the vertex region it has to be narrow and long in order to accomplish a filtering function, i.e. detect only those tracks that belong to the vertex and omit particularly beam tracks passing very near to the vertex;

ii) Far away from the vertex it ought to be shorter in order to improve the track detectability, especially when the subtended angle between track and slit becomes larger than 20^{o}.

Normally one tries to meet both requirements by a compromise in the slit dimensions, depending on track sizes, curvatures etc.

In a 1971 internal CERN report E. Rossa emphasized already the usefulness of a variable slit length.

The following proposal concerns an arrangement that allows the reduction of the slit length at any moment during the periscope movement, thus enabling to operate in the vertex region with a long slit and in the far field with a shorter one. Moreover, this could be installed without excessive modifications to the existing periscope assembly or photo-multiplier housing. The basic arrangement would simply consist of a fiber optics face plate for the slit, a double light guide, a two-arm relay light guide and a shutter. It would operate as follows:-

- The light falling upon the slit is separated into two channels by using a double light guide composed of two distinct light guides, each having a square shaped end face as shown in fig. 1. Each light guide picks up the light falling through the corresponding areas of the slit (which touches the end faces) and transmits it separately to the PM. Blocking the light coming through one of the light guides by a shutter is equivalent to a reduction of the slit length by an amount determined by the partition ratio at the entrance end.

A fiber optics face plate is the best suited substrate for the slit. It may be cut, ground, polished and anti-reflection coated like a solid piece of glass, but essential for the set-up is the fact that regardless of its physical thickness the optical thickness is zero. Square shaped pieces of fiber plates may be ground on two lateral faces to be used afterwards as references for the exact positioning of the slit. Fastening and adjustment of the plate in the periscope will be done by screws as is done in the existing machines.

In contact with the rear surface of the fiber plate will be the rigid fused end of a double light guide, consisting of two image guides ZM1, 2x2 mm of SCHOTT. These are called "raw bundles" which have only one end fused into a rigid rod. The rest of the length is left as a free-moving bundle. This is of particular interest since it allows the exit end to be given a special shape. For the considered application two such raw bundles are fused together at their rigid ends and then bent by 90°, as shown in fig. 1. The two bundles terminate in two concentric bushings, where one bundle is distributed concentrically around the other, inner bundle. This arrangement will keep the two light transmission channels separate during the rotation of the cone.

The relay light guide from the optical link within the periscope to the PM has to be made in a similar way, i.e. with a concentric entrance end and a two-arm exit end. Both arms will illuminate the same PM.

The shutter will block the light coming through one of the two channels. The type of shutter remains to be determined. One possibility is a liquid crystal shutter as they are coming of age now. The rise times of liquid crystal cells of 6μ active thickness are in the range of 1 to 5 ms. They require only a few μA at 20 V for excitation. A drawback of these cells is that they do not show an opaqueness of 100% when activated. At saturation they still scatter about 7% of the incident light in a forward direction, i.e. onto the PM, where it would raise the background noise level.

If this is intolerable, a shielded electromechanic shutter with a black teflon blade could be used instead. The activation time to fully retract the blade can be made to be in the range of 1 ms, which is equivalent to an angle of about 6° of one spiral.

Some additional points, directly related to the foregoing set-up, are mentioned briefly below:-

- Cutting the slit length also involves cutting the light flux falling upon the PM. The AGC will compensate for this effect.

- Cutting the slit length from one end only by an amount ΔL will shift the midpoint of the slit by $\Delta L/2$ and will thus alter the radius of the subsequent spirals by ΔR. If, for instance, 400μ are cut away at the upper end of a slit of 1000μ length, the new radius R' will be

$$R' = R - \Delta R = R - \Delta L/2 = R - 25 \text{ least counts}$$

with the least count of the radius coordinate being 8µ. The off-line software can easily take care of this effect.

- Cutting the slit length can be done at any radius. It is sufficient to add to the control program a few statements which will give a hardware instruction to actuate the shutter when the preset radius is reached.
- By proper adjustment of the fiber plate in front of the double light guide any amount of slit length reduction can be set. After this setting a recalibration of the radius is necessary.

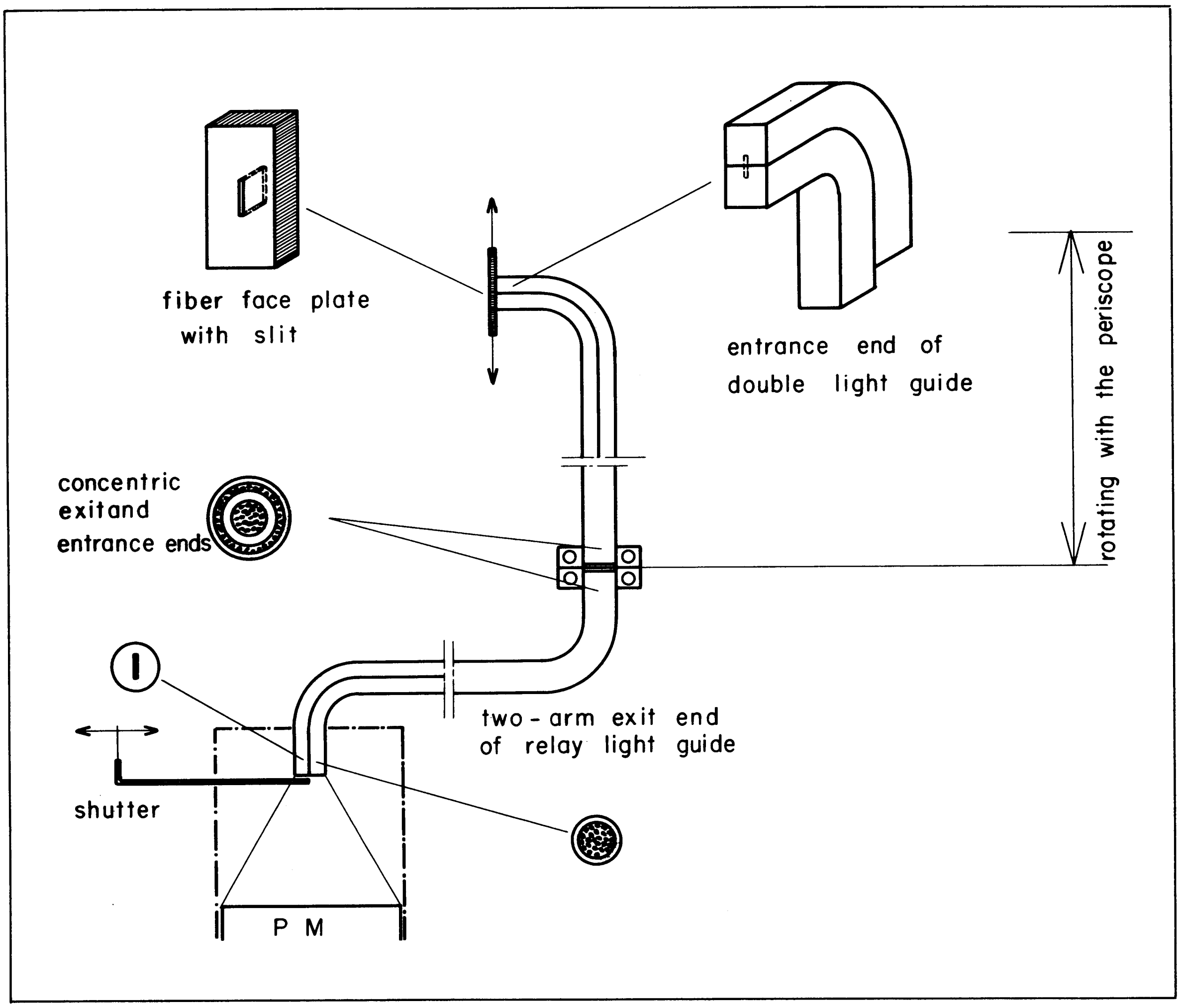

Fig. 1