УДК 514.18, 535.312

CONDITIONS RAY TRANSITING THROUGH CONIC LIGHT SHAFT AFTER ITS MULTIPLE REFLECTION

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Conditions of transiting of a light ray through light shaft in the form of a frustum of a cone.

Keywords: a conic light shaft, a mirror reflection, a light ray.

Formulation of the problem. Light shaft - a light cut of the upper light through which the natural light passes, the weight of which comes after a multiple reflection from the inside surface of the mine. The passage of the ray through the U.S. is an integral part of the geometric methods of modeling the illumination under the school and its efficiency. In particular, for the U.S. in the form of a cut cone, the geometric methods are realized in the works [1, 2] for the standard distribution of brightness with the usual cloudy sky [3]. However, these methods are not extended to other standard types of brightness distribution [3].

Analysis of recent research and publications. A similar problem is considered in the literature on optics [4, 5] and in relation to the concentrators of solar energy [6], however, in these papers, simplified conditions for the passage of the beam are given. In [5], two conditions for the passage of the ray in the axial (meridian rays) and arbitrary (spit rays) planes through the cone with narrowing to the initial basis are given. The first condition (Fig. 1): the direct output beam should intersect with a sphere whose center coincides with the vertex () of the cone of the LS, and the sphere itself intersects the cone in the circle of the input base. The second condition: the touch of a beam to the corresponding circle of the sphere. It was shown in [7] that for the rays in the axial plane the conditions given in [5] are not sufficient, at the same time the first condition is necessary. In [1], a sufficient condition is given only for rays in the axial plane.

Formulating the goals of the article. The purpose of the article is to develop a method for determining the possibility of passing an arbitrary beam through LS.

Main part. As in [8], we consider the inverse trajectory of a beam in a conical UL from the calculated point in the UL to the point on the upper U.S. (Fig. 2). It is known [5] that for an arbitrarily selected reflection of the output beam, the input beam passing through the upper base of the CS (eg, Figure 2) can either exist or not (if we consider the inverse of the trajectory of the output beam, then after a certain number of reflections will return to the base of the mine).

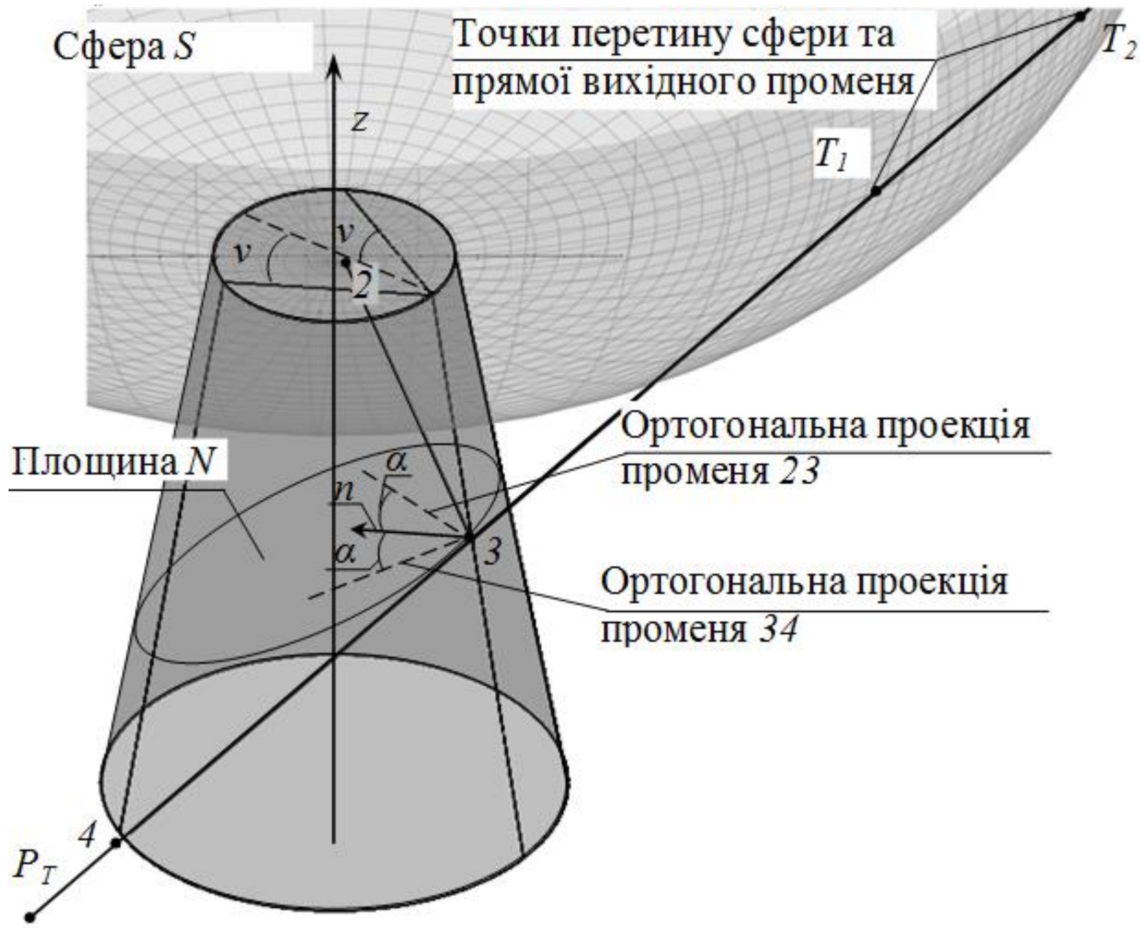

Fig. 1. Light mine, sphere S and the straight line of the output beam $3\,P_T$

If the ray passes through the LS, then it will cross the upper base (Fig. 2) at the point () on the chord formed as the intersection of the circle of the upper base and the creator (Fig. 3), on which are the points of two consecutive reflections of the ray. These creations and chords connecting their ends to the input (point A with the index of corresponding reflection) and the output (point B with the index of corresponding reflection) of the mine's foundations form trapezes.

Traps are sequentially deployed to the plane of the output beam 3 P_T (Fig. 3, 4), and we see that the condition of passing through a NAS of the ray that does not lie in the axial plane is the intersection of the scan of the beam and the corresponding scroll of the chord of the circle of the upper base. However, realization of this condition will be accomplished in two steps.

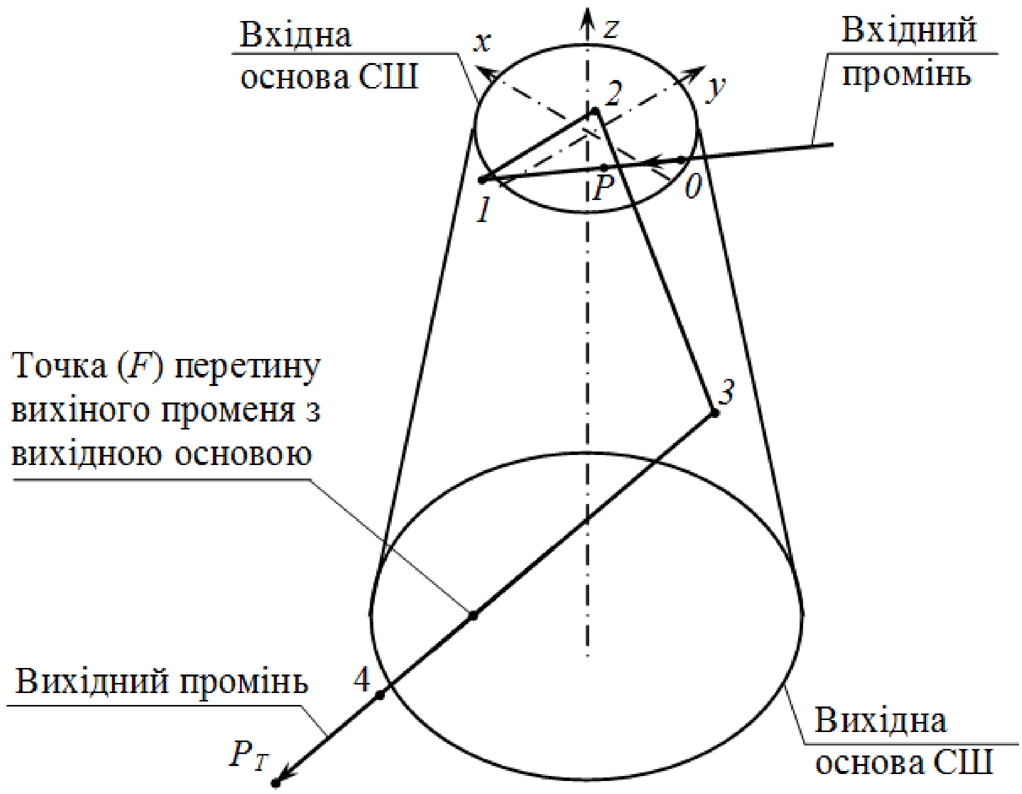

Fig. 2. LS and the trajectory of the beam

First determine the point (T_1)crossing a straight line passing through the output beam $3\,P_T$ (Fig. 1), with the sphere S, or else we determine whether there is a cross section of the sphere S and a direct output beam *3* P_T (Fig. 3,4). If the intersection exists, then determine its coordinates and the number of reflections of the beam k, rounded up to a larger integer ratio $\left\lceil \frac{\theta}{\varphi} \right\rceil$ (Fig. 4). Equality $k = \left\lceil \frac{\theta}{\varphi} \right\rceil$ It follows from this (Fig. 3) that all chords in the circle of the upper base, obtained by the intersection of this circle and the creators, on which the points of two consecutive reflections of the beam lie, are equal to each other. Orthogonal projections (Fig. 1) are equal to each other (α) on the plane N of the corners between the normal n and the tangent plane and the incident (23) and reflected (34) beams. Central projection of the angles α on the circle of the input base (centered at O_S) gives the other levels an angle between them ν. And these angles ν levels for all reflections of the ray, from which we have the equality of each other with the corresponding chords (Fig. 3) on the upper and lower bases.

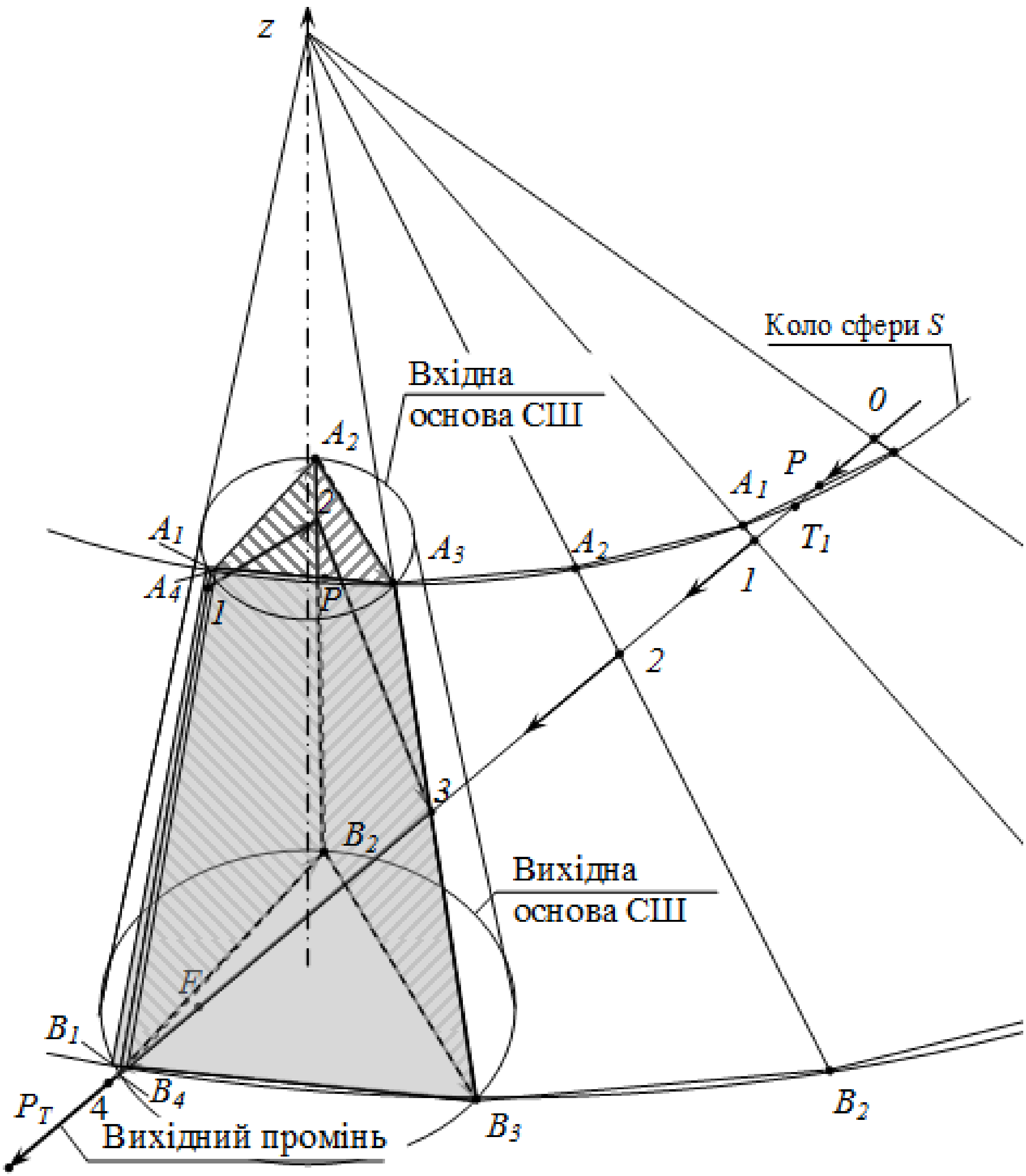

Fig. 3. Light shaft, the trajectory of the course of the beam and its sweep with the corresponding trapezia on the plane of the output beam $3P_T$

The second effect is to determine the point of intersection of the direct output beam $3P_T$ with chord A_0A_1 on the spin (the position of the mentioned chord is found by turning the chord A_3A_4 on the corner $k\varphi$ (Fig. 4)). If the point (P)There is an intersection, the ray passes through the school and calculates its coordinates.

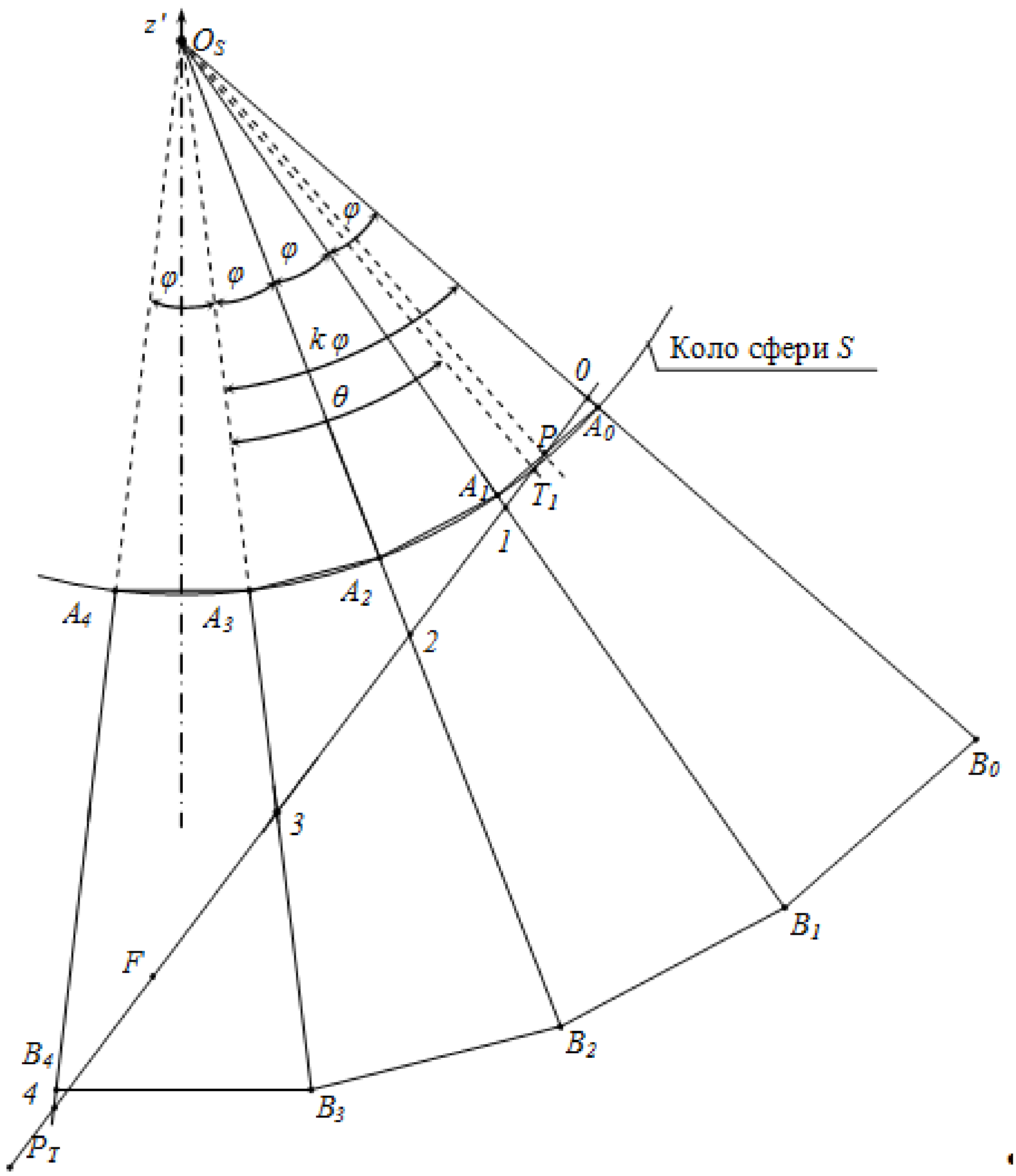

Fig. 4. Scattering of the beam and its corresponding trapezoid to the beam of the beam $3\ P_T$

Conclusion. A method for determining the possibility of passing a beam through the school is proposed. The application and program implementation of the method in the future is aimed at the development and implementation of a beam tracing algorithm in a conical light shaft.

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УСЛОВИЯ ПРОХОЖДЕНИЕ ЛУЧА ЧЕРЕЗ КОНИЧЕСКУЮ СВЕТОВУЮ ШАХТУ ПОСЛЕ ЕГО МНОГОКРАТНОГО ОТРАЖЕНИЯ

Зданевич В.А., Кундрат Т.Н., Литницкий С.И., Пугачев Е.В.

Проанализированы и дополнены условия прохождения светового луча через световую шахту в виде усеченного конуса.

Ключевые слова: коническая световая шахта, зеркальное отражение, световой луч.

УМОВИ ПРОХОДЖЕННЯ ПРОМЕНЯ КРІЗЬ КОНІЧНУ СВІТЛОВУ ШАХТУ ПІСЛЯ ЙОГО БАГАТОРАЗОВОГО ВІДБИВАННЯ

Зданевич В.А., Кундрат Т.М., Літніцький С.І., Пугачов Є.В.

Запропоновано геометричні умови проходження променю крізь конічну світлову шахту (СШ) після його багаторазового відбивання від внутрішньої поверхні шахти.

Ключові слова: конічна світлова шахта, дзеркальне відбивання, світловий промінь.