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2 Sheets-Sheet 1

Fig ~~Abb.~~ 1

Fig ~~Abb.~~ 2

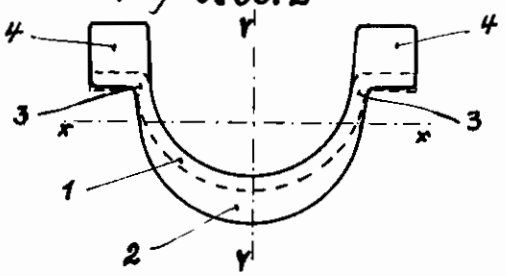

Fig ~~Abb.~~ 3

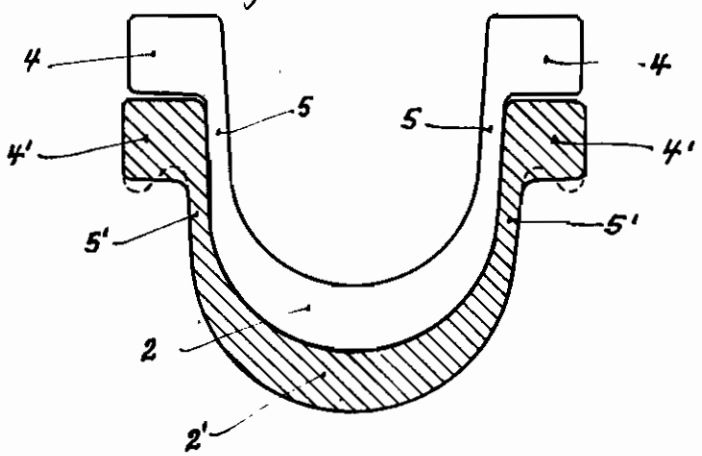

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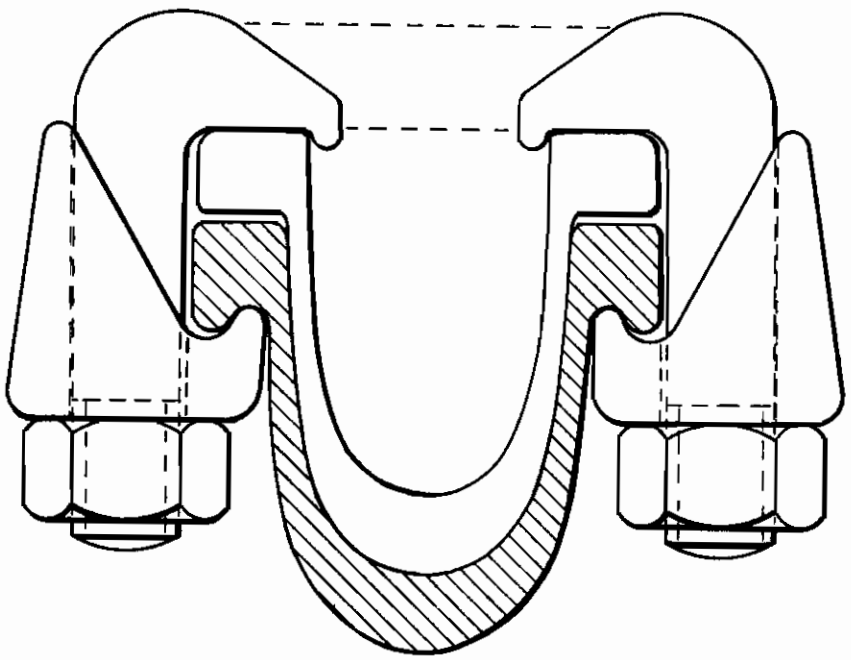
Fig. 4



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ALIEN PROPERTY CUSTODIAN

SEMI-TUBULAR SECTION WITH LATERAL FLANGES FOR USE IN MINE GALLERY FRAMING

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For several decades past it has been proposed to use tube halves equipped with flanges in conjunction with rock bodies and squeezable intermediary layers in vaulted adit framing heads, such tube halves forming likewise full cylinders when matched and representing in part the props serving to support the vault head. However, this semi-circular section with lateral flanges similar to the familiar cable protecting irons never gained any importance in casing or walling galleries despite the advantages it offered from the point of view of construction. There is no doubt that this method was completely ignored in practice for gallery walling owing to its insufficient staying quality to prevent gaping of the channel and its otherwise inadequate resistance against deflexion in consequence thereof.

The purpose of the present invention is to reform this familiar but, owing to its deficiency, practically useless gallery casing section and turn it into perfectly suitable shapes by revising or supplementing its design incidentally making it, if possible, superior to other known mine gallery casing sections. In accordance with the invention, this is achieved substantially by the following measures:

To start with, it is proposed to increase the thickness of the curved parts of the walls of the section steadily toward the center of the channel. In this manner, the channel wall is given a crescent-like section and, consequently, the section is assured a considerably increased degree of stiffness preventing any gaping of the flanges.

Generally, the growing reenforcement in accordance with the invention will presumably be of such a nature that the wall of the section at the perpendicular plane will be several times as thick as the thinnest portion of the rest of the channel wall, at least, however, about one and three quarter times as thick. In such a way, a degree of stiffness against gaping may be obtained in the section surpassing by far that of the channel-shaped sections known to be employed in mining practice and not possessing the crescent-like shape of the channel walls in accordance with the invention. The increased resistance against gaping increases considerably the effective value of the moment of resistance Wx of the section, the fact being that this decreases rapidly with the growing expansion of the channel section.

Furthermore, the advantage of the novel mine gallery framing is demonstrated by the fact that it is considerably better safeguarded against any bursting or splitting of the channel bottom in longitudinal direction than the channel-shaped adit framing sections known, such an occurrence—whereby the endurance of the whole gallery framing is greatly weakened and the reuse of the section is made impossible—being by no means infrequent. This longitudinal tearing open of the section as a rule occurs along the center of the bottom of the section. But at this point precisely, the turning point of the section halves producing a lever effect, the section in accordance with the invention is most strongly reenforced and, in addition, the gradual decrease in the thickness of the wall from the center towards the arm ends takes into consideration in an ideal manner the lever-like tendency of the section arms, particularly as regards the efficient distribution of the material.

Owing to the excellent degree of safety, the section in accordance with the invention affords against gaping and being torn open, the same may be most readily bent into curve or ring shape. For the same reason, the section is eminently suited for adoption in an arrangement by pairs for yielding or resilient casing in which the exterior section owing to the interior section being forced into the exterior one, is exposed to the additional danger of being bent or/and torn open.

The crescent-like shape of the channel section is formed effectively not only by the semi-circular curvature of the interior and exterior channel, but the curves may also take the shape of a parabola, or the like. In accordance with the invention it is recommended as especially advantageous to employ sections of semi-elliptic form or similar to a semi-elliptical form. This permits the use of a channel with steeply ascending arms and yet gradually increasing wall thickness with an even curvature beginning at or near the flange roots up to the perpendicular center plane of the section. This is of particular importance in cases where the section should show comparatively high moments on the axis x, for which purpose the channel must be narrow and deep. Long-armed channel sections of this kind also are provided with an extremely high degree of stiffness in the sense indicated, if shaped in accordance with the invention. Furthermore, even with a channel of considerable depth they may still be rolled with ease. As a matter of fact, any shapes in accordance with the invention may be rolled with greater ease

than any of the known casing sections which are more or less angular at the channel bottom.

For the purpose of obtaining the crescent-like shape of the principal part of the section wall in accordance with the invention, it is not necessary that both lateral faces of the section be curved in one and the same way within the scope of the curve types proposed; on the contrary, one may for instance to advantage give the inner wall of the main part of the channel semi-circular shape, while the exterior face may receive a continued curvature of semi-elliptical or similar shape, the reverse also serving as an eventuality to a certain degree.

In case of selecting a semi-circular shape for the curvature of the channel faces of the novel casing section, the lateral walls are supplemented in accordance with the invention by substantially straight-faced webs in continuation of the curved part of the channel, if the section required is a deep and narrow one. The same holds good in case flat semi-ellipses are preferred for the curvature of the channel faces.

It may be mentioned at this point that a flanged trough-shaped section has become known as a component part of a dissimilar pair of gallery casing sections, the inner faces of which are bent inwardly in a circular fashion, the interior bottom face also being curved inwardly, so that the interior section face resembles a parabola. This section, however, does not show the crescent-like shape of the channel wall in accordance with the invention and, consequently, it lacks the corresponding advantages, because the exterior faces of the webs, in spite of being circular as well, are curved toward the outside and the outside face of the bottom is of level shape. Said trough section does not possess the same high degree of rigidity resisting spreading of the channel section, nor can it be rolled as easily as the sections in accordance with the invention that have no corners or edges at the bottom. In addition, there is the considerable disadvantage that this trough section cannot be made up into a pair by insertion with a substantially similar and equivalent channel section, so that it will not fill the requirement of an efficient and resilient or elastic gallery casing frame.

For the purpose of converting the fundamental section in accordance with the invention into a section suitable for gallery casing and superior to other shapes it is proposed, furthermore, to make the flanges heavier and thereby bring their masses into favorable relation to the mass of the gradually strengthened bottom of the channel. Short-levered, substantially square, or short-length, substantially rectangular flanges decidedly would be given the preference over long-stretching shapes representing long lateral levers with the tendency to favor the gaping of the channel; and, as a rule, the thickness of the flanges will be several times that of the smallest dimension of thickness of the channel arm.

With reference to the drawing, the nature of the invention will now be further described and explained:

Fig. 1 shows the familiar semi-tubular section I mentioned in the beginning and resembling a cable protecting iron. The dotted lines 1' indicate how the original section in accordance with the invention loses its shape under the pressure of the rock.

Fig. 2 shows a specific design according to the invention by way of example In this case the crescent-like shape of the main part 2 of the channel wall is formed by two eccentric semicircles. As may be seen the channel wall increases gradually several times in thickness up to the center point, starting at the root 3 of the flanges 4, where its thickness corresponds to that of the original section, I, indicated in this drawing by a dotted line. The flange starting at the ends of the curvature extend to the same width as the flanges of the original section I. Their thickness, however, is also increased several times up to the point of reaching about a square section. The gradual increase in the mass of the material in the main part of the channel wall is compensated for by the heavier design of the flanges, in such a way, that the axis of symmetry and the neutral axis of the section coincide approximately. Thus, from the unstable, weak original section I a new gallery casing section of extraordinary resistance against gaping and tearing, with at the same time improved relation of the static values is created.

Fig. 3 shows a pair of sections formed of two similar sections in accordance with the invention, and especially adapted for constructing composite and resilient casing frames. A certain amount of clearance may be provided between the channel bottoms. They differ from the section according to Fig. 2 in that the main part 2, and 2' respectively, of the channel wall is not provided with the flanges 4, and 4' respectively, in an immediate continuation of the ends but with the intercalation of short and straight-faced webs 5, and 5' respectively. In this way, greater depth is given to the channels, the resistance moment Wx benefiting thereby, and the moments of inertia Ix and Iy being still closer adjusted one in relation to the other. As indicated by dotted lines, the flanges 4' of the exterior section may be provided with a groove or similar recess on their lower side, in such a way, that clamping devices may be adapted to it in a hook-like manner.

Fig. 4 shows another pair of sections in accordance with the invention held together by a novel clamping device. The cross sections of both channel shapes, as shown, are bordered in this case on both sides by lines resembling half ellipses, in such a way, that the section wall has its thickness increased several times gradually starting from the flange roots, to the perpendicular center plane of the section. Contrary to the aforementioned examples and the casing iron sections of the lining type, with this pair of sections the channel depth is considerably greater than the channel width. This fact together with the other features of the design in accordance with the invention, brings about that the interrelation of the inertia moments is radically changed as compared with the section cited in comparison, the moment Ix now surpassing moment Iy. It may be mentioned here that there is in existence an American channel section possessing strong lateral flanges and a narrow and deep channel which is used in tunnel construction as a skeleton rib center profile for supporting concrete timbering. This profile, however, would not be suitable for actual mine gallery casing, the frame work of which is composed, as a rule, of individual profiles. To a still higher degree than is the case with the fundamental profile of cable protecting iron type in accordance with the invention or the planking iron-like gallery casing sections, this profile lacks among other features a reliable reinforcement of the channel; as a matter of fact, precisely at the turning point of the section halves

where the wall must be strongest, this profile has by far its weakest part, being weaker even than the webs.

As in the design of a mine galley casing section the danger of lateral buckling also must be considered, the moment of inertia I_y must not be allowed, in relation to I_x, to fall below the point at which the direct or indirect friction of the profile at the gallery section joints no longer affords a sufficient supplement to the lateral stability of the section. As a rule, the latter will be the case when the value I_y falls below half the value I_x.

In cases, therefore, where a section resistant to bending stresses is of prime importance, it is proposed to design the cross sections of the shapes according to the invention in such a way that the moment of inertia I_y is smaller than the value I_x. At the same time, moment I_x should not surpass moment I_y by more than one and a half the latter's value.

There is a demand for channel shapes of this type principally in mine galleries of considerable span, such as for instance loading stations, gallery junctions, and the like, where, even if the frame work is given a round form, the bending or transverse strains will be more apparent, as a rule, than crippling strains. Furthermore, sections of this type may be employed to advantage in those cases of smaller spans where arch-like frames are used, the lateral parts of which have to show a comparatively large radius of curvature in view of the gallery height required, or in part cannot be given any curving at all. Such parts of the gallery frame work are exposed to a special degree to the danger of bulging out toward the gallery interior when impulsive pressure is existent, and in the headways to the danger of bulging out into the worked space, as long as the packing serving in this case as an abutment to the frames has not yet been introduced.

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