

MAREK WOJTAS  
DAMIAN KAZUBIŃSKI  
KLAUDIUSZ PILARZ

## AN INNOVATIVE CROSSING POWERED SUPPORT OF THE HENNLICH-20/43-CH TYPE

*The underground mining of minerals with a longwall system requires the construction of two parallel galleries (bottom road, top road). As the longwall progresses, they are eliminated (mining from the boundaries). Reconstruction of this area, i.e., the wall-road crossing, is usually carried out manually. Other methods can be used to reduce the physical effort of handling the wall. One way is to use supports dedicated to these locations and an example of such a solution is the HENNLICH-20/43-CH support. The article discusses the advantages of using mechanized power support as an alternative to development with individual props. The technical parameters of the selected type of mechanized power support are presented.*

Key words: *crossing support, road section, securing the wall-bottom road excavation, niche development, wall conveyor fitting*

### 1. INTRODUCTION

In deep coal mines in Poland, the most popular drilling method is the longwall system. It requires the successive rebuilding of road support elements in the area of the roadways as the longwall progresses.

With both cavity and non-cavity methods of longwall working, in order to allow the longwall miner to work at the end of the longwall, the roadside arches of the road support must be removed beforehand [1]. Incomplete arch road support does not perform its function of supporting the ceiling in such a condition, so it is necessary to secure the support of the double timber by using additional individual friction or hydraulic props, wooden punches and additional steel structures, rails and steel profiles [2]. Roadways can be removed behind the longwall face or maintained for further use in ventilation or work on more longwalls.

The traditional way of securing them is incredibly labor- and material-intensive. It also increases the possibility of accidents, as most of the work is performed manually with simple tools [1].

An alternative to the traditional securing of roadways by using individual props is to equip the crossing with a special powered support.

### 2. WALL-ROAD CROSSING SECTIONS

The use of a special road section significantly reduces the crew's involvement and physical effort in building up roadside arches, securing open doorways with individual props, and facilitates the transportation of various types of materials [3]. For this purpose, there are special transport lugs mounted to the roof-bars of the crossing support. Crossing powered support is also used to draw off the arch support behind the progress of the wall (Fig. 1).

The support section allows for mechanization of work related to:

- supporting the working roof in the roadway support with constant working support capacity,
- the reconstruction of the conveyor cross drive with the longwall progress,
- spontaneous “rebuilding (stepping)” of the set.



*Fig. 1. Arch support door frame type ŁP with bend side wall arch*

Special sections for the wall-road intersection are used in diverse geological and mining conditions, require proper wall progression, a high level of crew skill in handling, and do not need the support in front of the wall to be reinforced, while they do not reinforce the roadway in front of the crossing [3]. The road support is controlled from hydraulic manifolds located in the section in such a way that the operator is always under a stationary section segment or outside the section perimeter at a safe distance.

Several technical solutions of powered supports for use in a different range of excavation heights are known, e.g., HENNLICH 17/37 operated in the Wesola coal mine, HENNLICH 20/43 operated in the Staszic coal mine and the Marcel coal mine, FRS 18/38 operated in the Marcel and Jankowice coal mines [4].

In Poland, FAMUR and HENNLICH have been the main section suppliers in recent years. In the past, similar solutions were also supplied to the market by TAGOR and GLINIK.

### **3. CHARACTERISTICS OF THE HENNLICH-20/43-CH TYPE CROSSING POWERED SUPPORT**

The HENNLICH-20/43-CH type crossing support is a result of technical and economic cooperation between companies: HENNLICH s.r.o., based in Litoměřice and Przedsiębiorstwo HYDROMEL Sp. z o.o., based in Siemianowice Śląskie [4–5]. In a joint partnership based on the design developed at HENNLICH

and production performed at HYDROMEL, the goals of creating a functional product with genuine applications in coal mining were achieved. This cooperation resulted in the creation of a device – a crossing support that meets user requirements, as evidenced by joint – consortium transactions conducted for the needs of Polish mines.

The HENNLICH-20/43-CH powered crossing support is designed to support the roof of a roadway excavation at the wall-road crossing. The support is designed to work in the roadway excavation in the support of ŁP9; ŁP10 in the first degree of elevation and ŁP12. It is envisaged that the support will cooperate with wall conveyor drives equipped with a special plate for pushing the drives and the route of the wall conveyor.

The support design allows it to work in beds endangered and not endangered by subsidence in the height range from 2.2 m (2.3 m for subsidence seams) to 4.2 m in roadways with slopes along the roadway up to ca. 15° and across the roadway up to ca. 5°.

The support allows for mechanization of the following works:

- spragging of the section between the floor and the roof with initial support capacity,
- supporting the roof with constant working support capacity,
- correcting the alignment of sections,
- moving the set,
- assisting in the process of conveyor drive fitting and the route of the wall conveyor,
- set drawing off.

The crossing powered support is made up of three sections. The outermost right and outermost left sections have sill pieces and roof-bars connected to each other to form sets of roof-bars and far-end sill pieces. The duty cycle for the outermost sections is a common cycle. The center section is a separate subassembly, connected to the outermost sections via a sliding system consisting of two hydraulic cylinders.

The outermost sections consist of the following components:

- swing roof-bars I (right and left),
- swing roof-bars II (right and left),
- a set of outermost sill pieces,
- a set of outermost roof-bars,
- lemniscate arms,
- front connectors,
- rear connectors,
- a set of rear sheet metal.

The middle section consists of the following components:

- a swing roof-bar I,
- a swing roof-bar II,
- a middle sill piece,
- a middle roof-bar,
- a lemniscate arm,
- front connectors,
- rear connectors,
- bumper (drive pushing system),
- sill piece lifting system.

The system also includes props, cylinders and a hydraulic system.

In the starting position, the support is spragged in the roadway and pressed against the drive of the longwall conveyor route. After mining a section of the longwall equal to the miner's take, the drive is repositioned (fitting) along with a section of the longwall miner's route and the subwall miner's route with the assistance of fitting cylinders, located in the middle section of the support. After its completion, the middle section of the support set is repositioned by the take size. After performing the subsequent machining with the miner, the next step should be performed with the middle section of the set.

After the middle section is spragged, completing its maximum fitting, the outermost sets are rearranged, pushing them closer to the middle section (by a stroke – 1600 mm).

The HENNLICH-20/43-CH three-section crossing powered support is equipped with two sets of 18-function (or optional 20-function) controls. One set of controls, which includes a distributor and cables, controls the activities of the middle section, and another identical set handles the functions of the outermost sections. Control in the three-section set is implemented in a contiguous system [4–5].

As an option, the support is equipped with an electro-hydraulic radio control system (Fig. 2). Support control operations are carried out by a distributor mounted on the outermost right or left section, depending on the position of the wall [5].

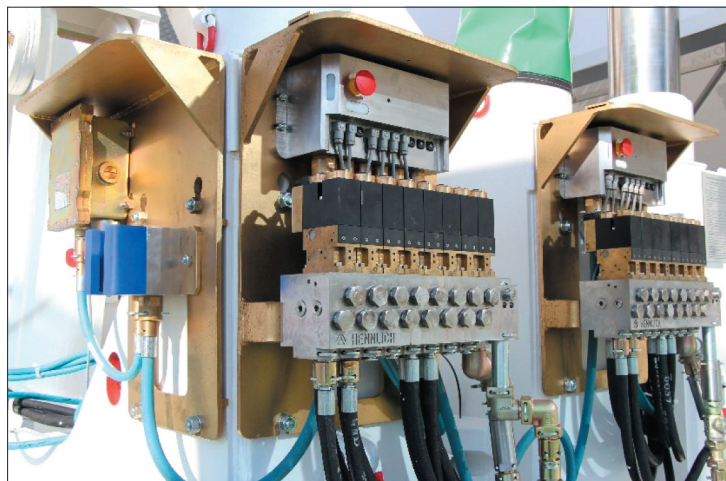


Fig. 2. Hydraulic distributors with solenoid valves and a radio control module

Support control operations are carried out by a distributor mounted on the outermost right or left section, depending on the position of the wall. The

main functionality of the system focuses on increasing the safety of machine and equipment operators by moving the control area away from local panels to

zones where the risk of human-machine-environment interaction is reduced, improving control precision by expanding the operator's observation horizon. The mControl\*\* control system consists of a radio remote control, one or two actuators and auxiliary equipment such as batteries and intrinsically safe power supplies and a battery charger module. Intrinsically safe power supplies the power actuators equipped with a radio circuit, an optical, audible signaling device, an emergency shutdown button, and two-state outputs connected to the coils of hydraulic distributors through routed connectors. The radio remote control used to control the binary outputs of the actuators is equipped with 20 switches with a stable "0" position, an "Emergency Shutdown" button, optical indicators, an antenna terminal and a powered battery power circuit.

The operation of the outermost sections is controlled from a distributor mounted on the middle section. The crossing support can also be controlled from the wall. In this case, the control distributors should be mounted on the first section of the longwall support. It is unacceptable to draw off the middle section and the outermost section at the same time. When one is drawn off the other must be absolutely spragged. The parameters of this support are shown below (Fig. 3).

Height range:

- geometric 2.00–4.3 m
- working 2.20–4.2 m

The support operation in the inclination range:

- along the set ca. 15°
- across the set ca. 15°

Support capacity:

- initial (25 MPa) 0.37 MPa
- initial (32 MPa) 0.39 MPa
- working 0.43 MPa

Maximum floor pressure:

- outermost sections 1.2 MN/m<sup>2</sup>
- middle section 1.11 MN/m<sup>2</sup>

Number of props:

- outermost sections 4 pcs.
- middle section 2 pcs.

Prop initial support capacity (25 MPa):

- outermost sections 4 × 1.227 MN
- middle section 2 × 1.227 MN

Prop initial support capacity (32 MPa):

- outermost sections 4 × 1.57 MN
- middle section 2 × 1.57 MN

Prop working support capacity:

- outermost sections 4 × 1.71 MN
- middle section 2 × 1.71 MN

Stroke of the set shifter 1.6 m

Stroke of the drive shifter 0.8 m

Shifting force:

- outermost sections 2 × 0.19 MN
- middle section 2 × 0.43 MN

Drive shifting force: 2 × 0.602 MN  
(middle section)

Additional drive

shifting force: 0.602 MN  
(outermost sections)

Force at the end of the swing roof-bar I:

- outermost sections 2 × 0.174 MN
- middle section 0.277 MN

Force at the end of the swing roof-bar II:

- outermost sections 2 × 0.028 MN
- middle section 0.057 MN

Supply pressure: 25–32 MPa

Set weight: ~45000 kg

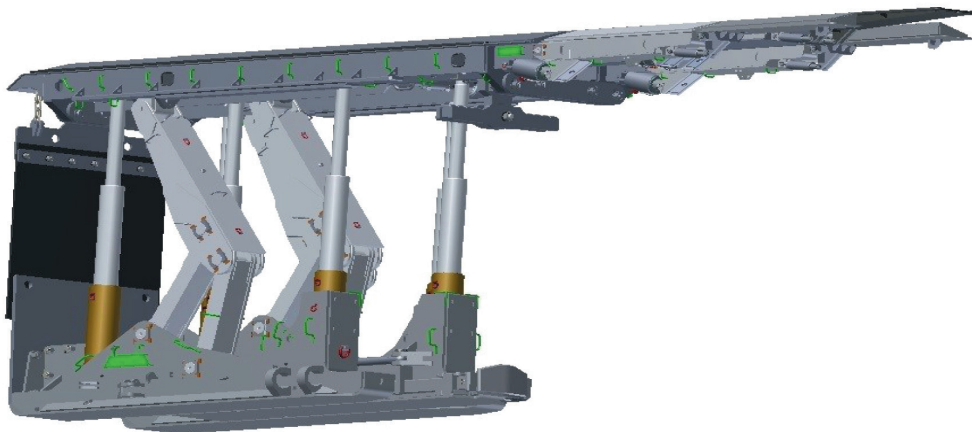


Fig. 3. Model of the HENNLICH-20/43-CH type crossing powered support

#### 4. CONCLUSION

The company HYDROMEL Sp. z o.o., founded on 29.06.1994, focuses its activities on specific industries, so that it has specialists in their fields, and mutual cooperation with many companies broadens its horizons and capabilities and ensures competitiveness in the market. As a Capital Group PUMAR has the following departments: mining, power hydraulics, energy, welded structures, and transportation [5].

Within the various departments, the company designs, manufactures, repairs and upgrades:

- longwall powered supports and their individual components such as structural parts, power hydraulics, cylinders, control hydraulics and hoses;
- construction of mining equipment, pressure vessels and pipelines;
- machine and equipment construction in the construction, transportation and energy, railroad industries.

In addition, we offer the following services: agency, financial and accounting, coal trading, transportation and shipping services within the country and the EU.

Tremendous value is derived from cooperation with many companies in the mining industry, resulting in the implementation of numerous projects for the mining industry, as well as the opportunity to innovate, conduct research and create prototypes [5].

One of these projects is to equip the road-wall crossing with a modern solution – a special powered roadway section (Fig. 3). It is convenient for the crew, reduces the risk of accidents occurring, and is eco-

nomically viable due to the reduced involvement of the crew in the manual cyclic reconstruction of the crossing.

Listening to the opinions of road section users, it is clear that these users can no longer imagine going back to the traditional solutions since they started using the new HENNLICH-20/43-CH type crossing powered support [4–5].

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MAREK WOJTAS, M.Sc., Eng.  
HENNLICH s.r.o.  
Českolipská 9,  
412 01 Litoměřice, Czech Republic

DAMIAN KAZUBIŃSKI, M.Sc., Eng.  
KLAUDIUSZ PILARZ, M.Sc., Eng.  
Przedsiębiorstwo HYDROMEL Sp. z o.o.  
ul. Wyzwolenia 14,  
41-103 Siemianowice Śląskie, Poland  
hydromel@ppupumar.pl