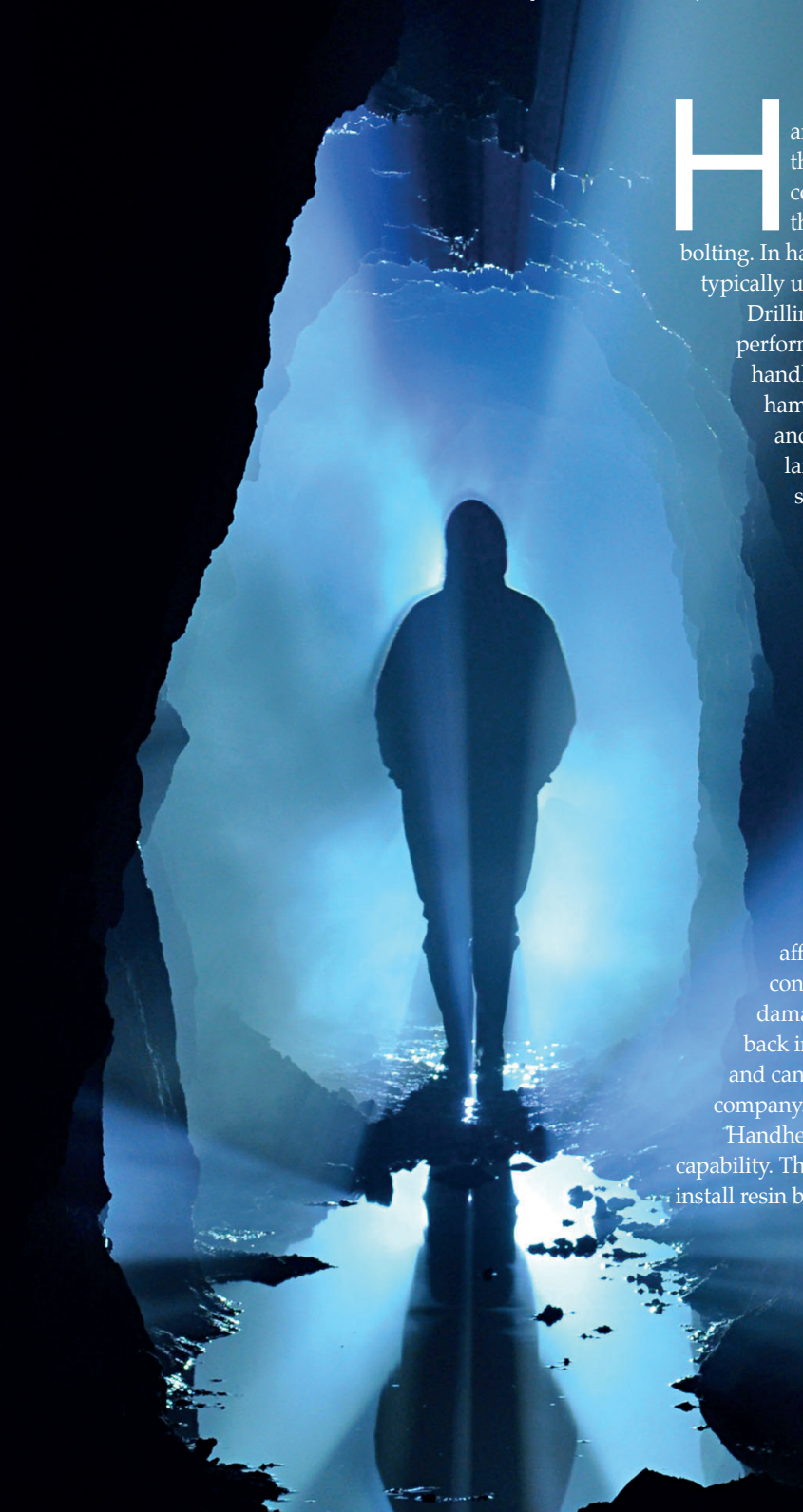
IN NARROW CONFINES

Bill Kendall, J.H. Fletcher & Co., US, explains how narrow roof bolters can improve safety in coal mines.



Handheld air, electric and hydraulic powered drills are used throughout coal mines. They can be found in use along belt conveyors, in single entry development, in entries where there are obstructions, as well as in longwall recovery bolting. In hard rock mines, pneumatically powered jackleg drills are typically used in narrow vein mining.

Drilling and bolting in narrow confines has traditionally been performed with pneumatically or hydraulically powered handheld drills or newer, electrically-powered handheld hammer drills, due to their low cost, simplicity of operation and flexibility. Mechanised equipment has typically been too large, too expensive, too inefficient due to the confined space and too restrictive for use in narrow confines.

Operators at risk

Although handheld equipment is effective, the nature of this equipment can put the operator at risk by exposing them to certain inherent hazardous conditions. These include:

- Falling rock from the roof, rib and face.
- Tripping hazards.
- Bending, twisting and lifting hazards.
- High noise levels.
- Chemical fumes from pneumatic exhausts.

The operation of handheld equipment can adversely affect the long-term health of the operator: for example, continual jackleg operation frequently results in long-term damage to hearing, shoulders, arm and wrist joints, as well as back injuries. These can severely impact the lives of operators and can result in higher personnel turnover rates for the mining company.

Handheld drills also typically have limited thrust and torque capability. This limits their ability to push long resin bolts, properly install resin bolts and to properly torque mechanical or tensioned rebar

bolts. Handheld drills do not offer any type of protection for the operator from roof or rib falls. They do not offer any means for handling roof or rib mesh. Since the operator stands on the ground, the maximum safe drilling height without use of a ladder or "riding the drill" is limited to 8 ft (2.44 m).

Mechanised equipment

Purpose-built, mechanised equipment with adequate flexibility can improve workplace safety, reducing operator exposure compared to handheld equipment. It can also improve the health of the underground miners in coal and metal/non-metal mines. Fletcher began developing a new generation of narrow machines in 2012 with the intent to improve safety for workers installing ground support in narrow vein operations, as well as in confined areas in coal mines, such as along belt conveyors, in single entry development or in tailgate areas where existing supplemental support may prevent use of a wider machine.

Fletcher developed (and has tested and proven in field trials), a narrow 4 ft 6 in. (1.37 m) wide, articulated-chassis, lifting-boom-type, "man up" roof bolter for installing ground support in entry widths down to 6.5 ft (1.98 m) wide and up to 14.5 ft (4.4 m) high. The machine is rubber tyred and has a tram speed in excess of 4 mph (6.4 km/hr). This enables it to quickly tram relatively long distances and also provide an efficient means of installing supplemental support in haulage and transportation entries. This machine compliments an existing 4 ft (1.22 m) wide machine, which uses crawlers for tram.

Typical jackleg operation.

Basket swing can be used to keep the basket parallel to the stope when the boom is swung.

Chassis fully-articulated boom and basket fully-swung stabile with 6000# load in basket.

Machines in use

Three machines of this type were built in 2013 and operated over a one year period in platinum and gold mines. A fourth machine is currently being built for use in a nickel mine. Although these machines were originally developed for specific hard rock applications, they also have a variety of applications in coal mines, including supplemental and cable bolting.

The specs

The machine can be equipped with a rotary or rotary percussive drill head. It can be equipped with water flushing or a vacuum-type dry dust collection system. The drill mast (feed) can be made in various lengths. Currently, it uses a short rotary percussive hydraulic hammer (20.25 in./0.51 m tall) on a double telescopic feed frame, which is only 72 in. (1.8 m) long and provides 77 in. (1.96 m) of feed length for a single pass installation of 6 ft (1.8 m) bolts. The feed provides 7000 lb (2613 kg) of thrust. The drill heads provide up to 350 ft-lb (475 Nm) of torque. The feed includes drill steel guides and clamps. The machine can install friction, expandable, mechanical, resin, tensional rebar and cable bolts with no alterations to the machine.

With 40° of chassis articulation, the machine can negotiate turns with as little as 2.5 m (8.3 ft) inside radius. The bolting boom includes 40° boom swing

and boom lift. The bolting basket can swing 30° and tilt. This freedom of movements allows the bolting basket to reach around corners, while it can alternatively be kept parallel with the chassis, even with the boom swung completely to one side. It is also able to keep the bolting basket level, even when bolting on ramps up to 10.2°. The lifting boom allows the drilling basket to set flat 6 in. below grade or lift it 4.5 ft (1.37 m) so that the drill unit can reach to a top height of 14 ft 6 in. (4.4 m), eliminating the need for backfilling before roof support can be installed.

The Mine Safety and Health Administration (MSHA) approved canopies provide protection to the operator in both chassis and basket work positions. The operator can tram and control all drilling and bolt installation functions from the basket. Basket sidewalls and collapsible rock guards protect the operator while bolting.

A mesh handling assembly on the mast allows the machine to lift and position roof mesh into position for surface control. The operators have successfully used the machine to lift and position wire mesh panels up to 12 ft x 4 ft (3.66 m x 1.2 m) into position against the top or side of the headings. The operator can then bolt the mesh into place without leaving the machine, installing "mickies", or setting scaling bars.

The operators bolting compartment and canopy is mounted to a lifting boom, which keeps the operator at a convenient height for bolting. This feature, coupled with the feed being mounted on dual rotary actuators, allow bolts to be installed reasonably perpendicular to all entry faces – even at full height. The machine can bolt from floor to floor sideways and can also bolt the face.

It has been built in a full diesel and also a diesel tram/electric bolt configuration. The bolter is capable of negotiating uneven floor, 90° turns in narrow openings and ramps of up to 19% grade. The operator is under a protective canopy for protection from rock falling when bolting and when installing mesh. The noise level for the operator has been reduced by over 8 dB compared to a jackleg. The machine drills at 0.75/sec. (3.75 ft/min.). The machine inserts 5 ft (1.5 m) friction bolts in 9 – 10 sec.

Bolting the face.

Bolting at 3.6 m (12 ft).

Summary

This new machine concept could prove to be a significant step forward in improving safety for installing ground support in narrow confines. Those in the coal mining industry looking to install roof bolts, while also improving the safety of their workers and drilling operators, would do well to consider options such as these when managing their operations. WC

Rib bolting in 2 m (6.5 ft) wide heading.