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## Progressing Toward Automation and Improved Productivity

Over the past 10 years, J. H. Fletcher & Co. has made significant advancements in improving roof drill productivity and automation. We currently have prototype and production machines working in the field, some for as long as ten years. These machines boast various degrees of automation and incorporate many new concepts. Over the past ten years, we have invested considerable time and money in an effort to meet the increasing productivity demands created by the development of modern continuous miners and haulage systems.

**1988** In 1988, a remotely operated bolting module for high seam applications was placed in operation at a Kentucky Limestone mine. This bolting module, installed on a boom capable of bolting in up to a 25' height, included a bolt carousel and a resin cartridge carousel containing enough supplies to install ten bolts. The bolting module is operated from the operator's cab located on the machine chassis.

One of the major developments related to this system, is our patented mechanical resin inserter. The unique design of this resin inserter has proven to be very dependable when compared to the pneumatic resin inserters utilized by other manufacturers.

Fletcher machines of this design are currently operating in gypsum and salt mines in the United States, as well as metal mines in South Africa and Poland.

**1989** In 1989, Fletcher entered into a joint venture with Shell Mining to develop an automated twin boom roof bolting machine. This machine was designed to allow a single operator, located in a cab in the center of the machine chassis, to install all of the bolts needed for a 40' miner cut without reloading. This was our first venture into the application of a PLC (Programmable Logic Controller), which was utilized to allow one operator to operate two drill units simultaneously. Although the machine was tested extensively underground, the project was not completed



**1988 ARR-D  
Remotely Operated Bolter**



**1989  
Automated Twin Boom Roof Bolter**

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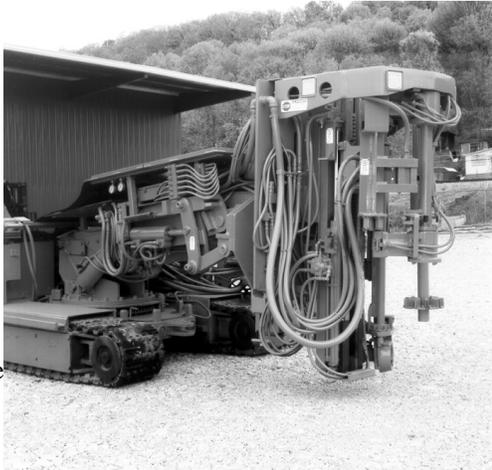
before Shell sold their U.S. coal operations.

The project was a valuable step toward advancement of our automation concepts in all aspects including mechanical arrangements, hydraulic actuator sensors, and PLC applications. It was clear that continuing R&D efforts were warranted with the emphasis on a single compact automated bolting module, which could be adapted in multiple units on place changing machines or potentially on continuous miners and other equipment.

**1992**

In 1992 the compact drill module was first tested underground. During this period, the PLC

controlled automated drill "feedback system" was tested and perfected. The feedback system proved to out perform the most skillful operator. The system attained penetration rates in fairly hard sandstone of 17 feet per minute. It was proven that such factors as single pass drill rod stability and



**1992  
Compact Drill Module**

optimum bit life could be combined with maximum penetration rates for a safe and highly productive system. Later, the machine was tested at a Trona mine in Wyoming. Operating in the opposite extreme from sandstone, the feed back system proved effective in vacuum drilling the soft gummy trona. The benefit of the vacuum sensors was proven for controlling penetration rates to within the capability of the dust collection system, and the arrangement is currently patent pending.

Another important development gained by the PLC is automation of resin bolt installation which provides consistency well beyond that of manual control. The system, using a single control, provides rapid insertion with slow rotation of the bolt through the resin cartridge, a pre-programmed spin time, and a pre-programmed hold with thrust time which is consistent for each bolt installed and programmed per the resin suppliers instructions.

**1994**

In 1994 a drill module was designed and sold to the U. S. Bureau of Mines Spokane facility for utilization of an electronic control system to establish optimum drilling parameters in a wide range of minerals. Through this project we gained additional experience with control loops and interfacing electronics with hydraulics.

**1997**

In 1997 work began on our four head semi-automatic, computer controlled bolter currently undergoing tests underground. Two operators



**Four Head Semi-Automatic  
Computer Controlled**

each operate two drill units, which are controlled during drilling by the feed back system. The prescribed single pass hole depth is drilled, and the drill automatically retracts the drill rod, guided and retained by drill guides, to a "park" position. While the holes are being drilled, each operator loads the two carousels for his drills with a bolt with bearing plate and resin cartridge. The carousel's three positions index to store the drill rod, index for resin insertion and index for bolt insertion. Following bolt installation, the carousel indexes to reinsert the drill rod into the chuck and drill guides.

During trial operation of the four head bolter, numerous "bugs" have been discovered and corrected, resulting in steady progress. The major remaining problem is reliability of the interface between the I.S. electronic control and the solenoid operated valves. With rapid advances in this type of technology, simpler and more reliable systems are now available. We have established that a semi-automatic four-head drill can be operated effectively by two operators with significantly increased productivity. We are achieving cycle times of 3.25 minutes per row, including set-up, using 5' fully grouted resin. The goal is 3 minutes and we are confident that we will reach this goal.

The next phase of our R&D program will be to build upon our experience with the current four head bolter with the addition of an automated extension rod system. This phase will also include two-section bolt installation, as well as investigation of flexible cable bolts for bolt lengths equal to or greater than mining height.

**Today and the Future**

We have entered into a joint venture with Kennametal to improve drilling technology. Kennametal has developed innovative bit concepts, which must be used for maximum benefit with the drill feedback system to automatically adjust thrust and rotation speed to varying strata conditions. We are currently assembling a drill module, with electronics to provide a feedback system, for test drilling at Kennametal's R&D facilities in Pennsylvania. After viewing several prototype bit designs, we are optimistic that an improved roof drilling technology will soon be available.

We currently have on order from one of our electrical suppliers, a control package which will allow the utilization of

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programmed feedback drilling control on our arm feed style drilling units (as used on RR-II, DDO and HDDO model machines). This system will allow the machine operator to select drilling control for optimum penetration rate and bit life as well as program resin mix and set settings per the resin manufacturer's specifications. As a by-product, data can be extracted from the PLC to provide a roof strata profile of each hole drilled. Feed rates and pressures will be regulated based upon roof hardness and column strength of the drill steel. This will eliminate bending and breakage of steels. Rotation speed and torque will be regulated to increase bit life and optimize cutting bite – resulting in larger cuttings and a reduction of dust. The vacuum sensor in the dust collection system (patent pending) will activate the control system to slow down the feed rate before the dust system becomes clogged.

We will be offering drill feedback and resin bolt installation electrical control as an optional feature on all new as well as modernized machines.

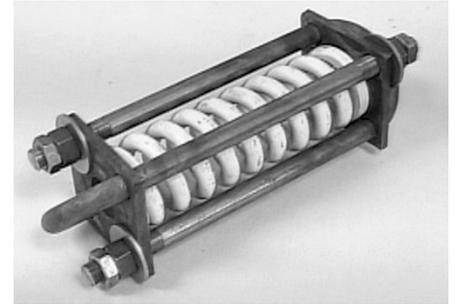
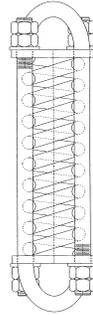
Currently, we are considering the development of a four head roof bolter to work in a coal mine with a mining height range of six to twelve feet. Proposed major design parameters are:

- a. The machine must retain the same operational flexibility as our current HDDR machines as far as roof, angle and rib bolting over the proposed mining height range.
- b. The machine must be reliable.
- c. Bolting rate for roof and ribs must keep pace with the continuous miner.
- d. The machine will utilize a combination of hands on as well as automation steps to provide the best possible combination of safety, reliability and productivity.

Throughout our history – J.H. Fletcher & Co. has been eager to develop new machine designs to meet unique individual customer requirements. We believe this approach – the development of “site specific” machine arrangements through the cooperation and input of mine personnel, will be best for the development of successful four head machines.

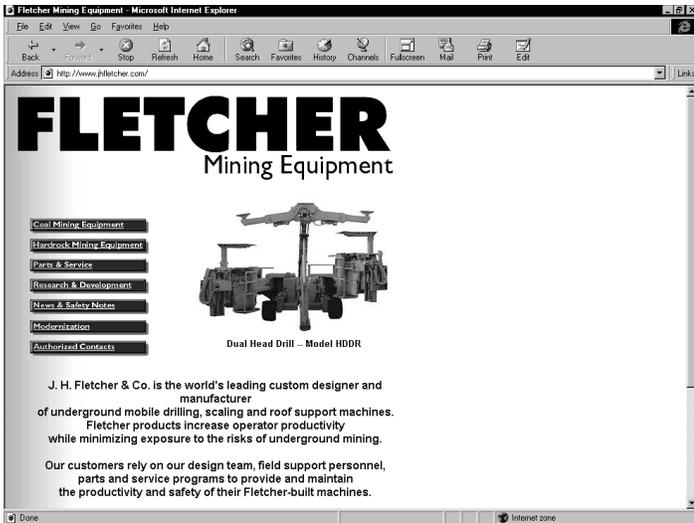
We look forward to the challenges as well as the opportunities involved in the development of this new mining technology.

## ATRS Leveling Spring



Fletcher now has available a new Compression Spring Trap Assembly (part number 292366). The spring is used in conjunction with twisted cable in order to keep the ATRS level while raising and lowering. Currently this design is available for Scissors and L Style ATRS systems with hydraulic extending beams. The pictures below shows the assembly on a typical Fletcher scissors ATRS.





J. H. Fletcher & Co. can now be found on the World Wide Web. The address is [www.jhfletcher.com](http://www.jhfletcher.com). The site offers information on Fletcher equipment, Parts & Service, Research & Development, News and Safety Notes, Modernization and Authorized Contacts. Check the site for occasional updates and new information.



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