Newsletter

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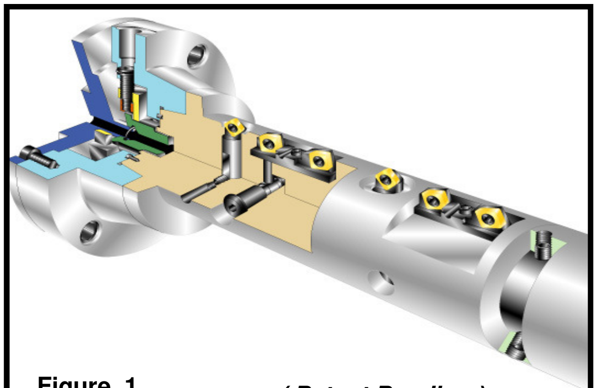

Figure 1 (Patent Pending)

(Patent Pending)

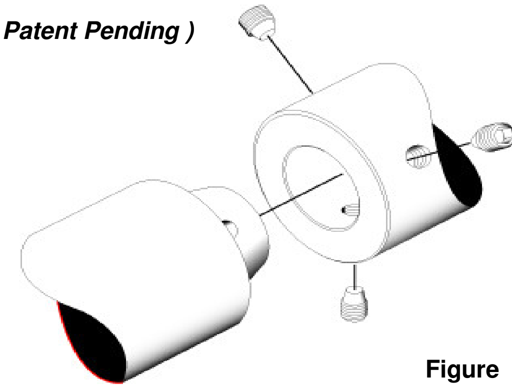

Figure 2

The number one criteria for a line boring bar is to be straight and true. If the bar is bent the resulting holes being machined will not be round nor will they be in line.

The basic problems only begin with the manufacturing of the bar. Since the line bar must be machined and then heat treated (to as much as 60 Rc) keeping the bar straight is a big issue. In fact, it is impossible to machine a bar 2 or 3 inches in diameter and over 30 inches long - heat treat the bar - and not have the bar bent from heat treatment. Therefore, line bars are generally stress relieved and straightened after heat treatment.

Although some of our competitor's have made attempts at manufacturing line bars in short segments, Master Tool has perfected the practice. The basic reason Master Tool has succeeded while others have failed is because of the joint used to hold the segments together.

Our competitors attempts have used a straight shank style of connection to join the segments. The problem with this connection is two fold. First, a straight shank in a straight hole has an obvious run-out problem because of the manufacturing tolerances between the two. Secondly, this joint lacks strength because while there is face contact, there is only line contact on the shank, permitting movement and vibration.

Master Tool has chosen a solid, stub tapered joint. This joint is patterned after the hollow DIN HSK joint we commonly use in industry as a quick change connection. The joint provides full face contact and a minimum of 80% surface contact on the taper (***see Figure 1)***. The joints in the split bar consist of matching internal and external tapers in the center portion of the bar and a flat annular portion near the outside. The joint is held together by three set screws with conical ends. Tightening the screws provides a force, which draws the joints together until the flat annular portions are in contact ***(see Figure 2).***

It is possible to heat treat segments up to 20 inches in length without going through a straightening process. Because the run-out of this tapered joint is less than .000050 (1 micron) the bars are perfectly straight when they are joined together. Now other features such as through coolant holes are much easier to manufacture.

Master Tool was originally concerned about the bending strength of a pieced line bar. The difficulties of other manufacturers using

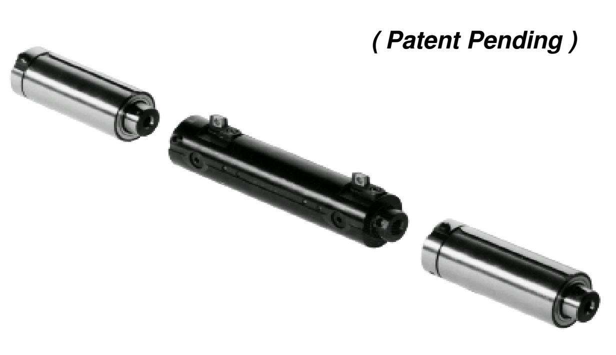

Figure 3

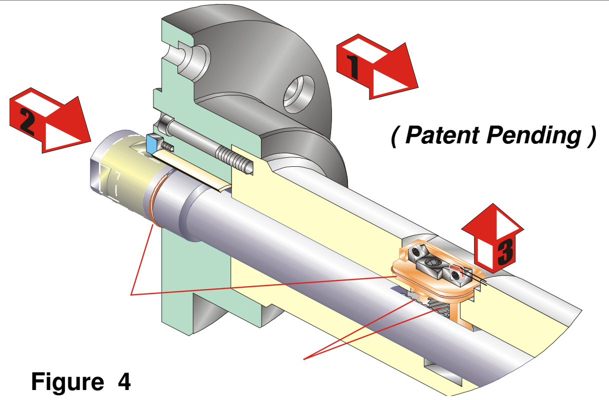

Figure 4

the straight shank connection has caused an industry perception that pieced bars are weaker than solid bars. In lieu of this, Master Tool contracted Cleveland State University to conduct a deflection analysis of our pieced bar.

During their analysis, Cleveland State assumed the cutting forces to be 40 lbs. in the tangential direction and 20 lbs. in the radial direction (this is approximately three (3) times that of the actual cutting forces in cast iron).

Their set screw calculations show that each screw contributes a force of 9000 lbs. to pull the tapers together and maintain contact between the annular potions of the joint. These calculations were based on an interference between the conical end of the set screw and the cone shaped depression in the tapered portion of the joint. The analysis also showed only 200 lbs. of force is needed to close the joint, even at maximum material condition. The remaining force from the set screws is available to prevent separation of the joint under load.

Cleveland State calculated deflection amounts for both a solid and split line bar assembly of the same diameter and length. The split bar had three (3) joints. Both types of line bars show very small deformations under cutting forces, with the solid bar deflecting a maximum of 0.001897 of an inch near the center and the split bar having 0.001907 of an inch of maximum deflection.

The conclusion of Cleveland State's analysis indicates that the split three-piece line bar has the same deflection performance under cutting loads as the solid one-piece bar. The joints remain in contact during cutting operations with significant residual clamping force.

Another advantage of segmented bars is the ability to offer unique designs such as line bars with rotating bearings as a part of the bar ***(see Figure 3)***. In addition, line bars with feed-out and internal draw bars ***(see Figure 4)*** are now a real possibility. This type of line bar eliminates the tradition "lift and drop" process on crank bore machining on an engine block. By eliminating the "lift and drop" this station now becomes a direct transfer like any other station. This dramatically reduces the cost of the station and the cycle time - many times eliminating the need for a split (A and B) line for crank boring.

For a complete copy of the Cleveland State University study please contact Master Tool Corporation.