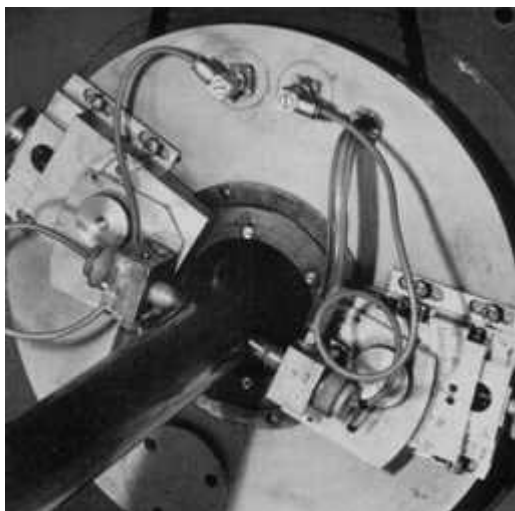


超声波探靴式旋转头技术发展史

上世纪六十年代之前，4.5 英寸（114.3mm）以上的钢管进行超声波全管体探伤，大部分采用的技术为钢管旋转形式或者钢管螺旋前进形式，这些技术即使采用多组探头，对产能限制也很大，不能匹配钢管轧制的速度。鉴于此，并简化钢管翻送流程，基于英国 Corby 的 SL 公司的 DR/&TD 研发部着手研发了旋转头技术。



RP6

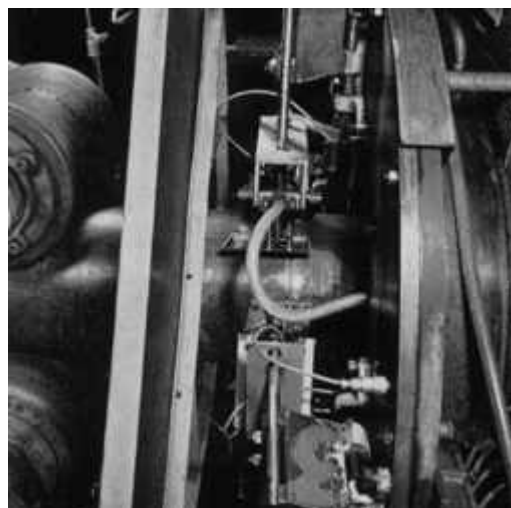
对于小管，现在包括其它一些无损探伤公司已采用旋转头技术，这些旋转头采用传统的**机械轴承和水腔**（非接触）技术，通常适用于管径小于 100mm 的钢管探伤。DR/&TD 首先研发了大管径旋转头，采用**水膜轴承和水注探头**，生产的产品安装和应用到 SL 公司的多个工厂，最大管径到 169mm。SL 之后变为英国钢管公司。这些最早设计的产品授权 Davey 仪器公司，以 Heliscan 为商标，也卖到世界各地的工厂。

这种类型的旋转头采用**水注非接触探头系统**，虽然检测速度相对较低，但还是非常成功的应用到了焊管和冷拔管产品中。但对于无缝管，钢管的直度变成一个很严重的问题，特别在钢管端部，这意味着需要研发更复杂的探头机构。

这个解决方案便是研发**探头块/探靴结构**，在上边可安装更多的探头，该探头块骑在钢管表面，在检测过程中，跟踪钢管的弯曲，保证了超声波的入射角度不会随钢管的弯曲而变化。

为适应 OCTG（石油专用管）的管径范围，需要检测更大的管径，并且探头数的增加和相应的更复杂的探头机构，都意味着轴承需要更大的负载能力。这最终导致世界上第一个**液力轴承**应用于旋转头探伤系统。到 1970，采用这种轴承的旋转头在英国钢管公司研究中心生产出来。采用液力轴承应用于超声波旋转头，明显的有点有：

1. 很高的负载能力
2. 无磨损，这是由于在定子和转子间，没有机械接触。



RP18

3. 水同时用于轴承和超声波耦合介质，不需要象机械轴承一样需要密封，从而简化了机械设计。

第一个液力轴承旋转头用于 RP18，可检测管径范围为 4½” to 18” O.D (114-457mm)。同时，第一个基于探靴设计的探头块也开发出来，这个设计采用气缸作用于带弹簧的探头块上。但这种作用方式不太稳定，最终改进为**自作用系统**：用平衡块产生的同心力来使探头块保持接触在钢管上。这种设计构成今天旋转头的基础，并从八九十年代开始陆续生产这类产品(RP20)销往世界各地。

小一些的旋转头 RP200 和 RP350，仍采用液力轴承和自作用探头组件技术，在 Corby 的英国钢铁技术中心生产产品，直到 1991 年该中心关闭为止。

那时，1991 年英国钢铁技术中心关闭，旋转头研发相关的一些工程师便组建了现在所知的 UNICORN 公司，这样保证了这项技术超过 50 年的研发的连续性。从 1991 年开始，Unicorn 公司进一步继承和发展了旋转头和探头作用机构技术，能够安装更多的通道，运行更高的旋转速度，这样就可提高检测速度，同时还开发了可用于检测非切头管和墩粗管的能力。



过去 10 年，Unicorn 在世界各地主要钢管产地销售 **Unicorn UR350/S** 安装了很多旋转头产品。即使现在，下一代旋转头产品研发计划仍在进行中，新产品将达到更快的检测速度，并改善维护特性，节省成本。

Unicorn 现在可以提供的探靴式旋转头产品，覆盖的管径为 38mm to 700mm。

原文: <http://www.unicorn-automation.co.uk/article4.htm>

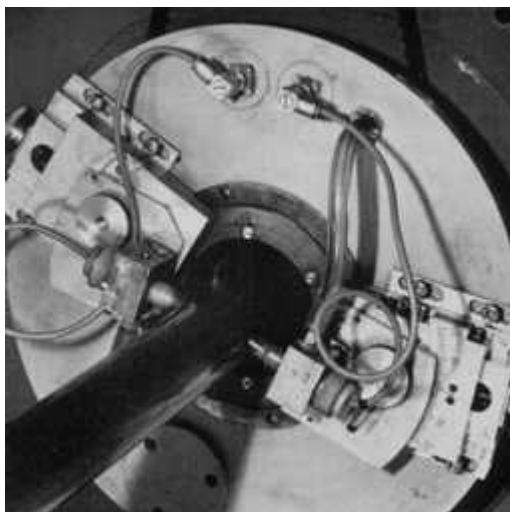
Ultrasonic Contact Shoe Rotary Heads A History of Development

Prior to the 1960's most of the full body ultrasonic tube testing systems for tubes above 4½" OD relied on the technique of either rotating or spiralling the product under test. This type of approach was, and still is limited in the testing speeds that could be achieved and even with multiple banks of transducers, the testing speeds could not match the production requirements of the typical tube mills. For this reason together with the aim of simplifying tube handling in a tube production/flow line the then Department of Research and Technical Development (DR&TD) of the Stewarts and Lloyds company based at Corby in the UK embarked on the development of ultrasonic rotating heads.

For the smaller diameter tubes rotating heads were already beginning to emerge from other commercial N.D.T. companies; these heads used conventional bearings and water chambers and were generally restricted to diameters less than 100mm. The first larger diameter heads developed by the DR&TD

Corby used hydrodynamic bearings and carried water jet transducers; heads to test diameters up to 6⅝" O.D. were produced and installed in various plants within the Stewart and Lloyds group, later to become British Steel Tubes Division.

These initial designs under the trade name of Heliscan were also supplied to various companies around the world, under licence by the Davey Instruments Company.



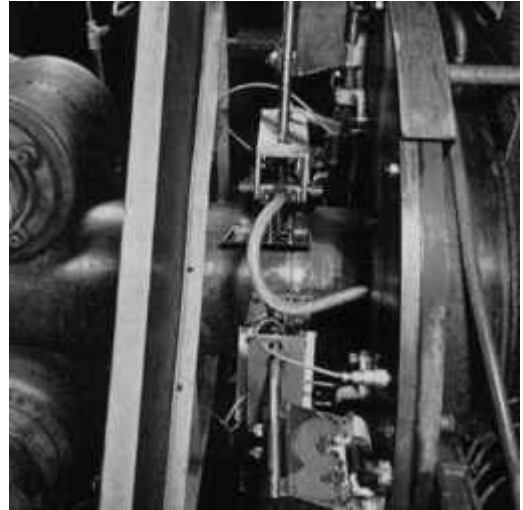
RP 6

This type of rotary head with its water jet non-contact probe system proved highly successful for welded and cold drawn tube type of product, although testing speeds were relatively slow. For seamless pipe however, it soon became apparent that out of straightness conditions particularly at the pipe ends meant that a more sophisticated probe mechanism would be required; the solution was to develop a probe block/shoe containing an increased number of transducers which actually rides on the surface of the tube and follows the pipe bends during testing.

Increasing numbers of transducers together with the requirement to test the larger diameters in the OCTG range and the increase in weight due to the more complex probe assembly mechanisms meant that a

bearing with a higher load carrying capability would be required.

This ultimately led to the development of the world's first hydrostatic bearing to be used for a rotary device and by 1970 rotating heads using this type of bearing began to be produced by the then Research Centre of the British Steel Corporations Tube Division based at Corby. The major benefits which were realised when using hydrostatic bearings for ultrasonic rotating heads were (i) high load carrying capabilities (ii) virtually no bearing wear since there is no metal to metal contact between the static and rotating parts and (iii) water is used for both bearing and the ultrasonic coupling medium, which avoids the need for seals and simplifies the mechanical design. The first hydrostatic bearing head to be produced was known as the RP18 with the capability to test pipe diameters in the range 4½" to 18" O.D.



RP 18

At the same time the first contact shoe design probe assemblies also began to emerge; these designs relied on a pneumatic application system with spring loaded probe blocks. The early designs proved to be unreliable and this finally lead to the development of the self-applying system whereby the probe block was kept in contact with the tube by means of the centrifugal force generated from a counterweight. This simplified design formed the basis of the designs in use today and a succession of rotating heads (RP20's) have been produced throughout the 1970's and 1980's and installed at various locations around the world.

Designs for smaller RP200 and RP350 rotary heads, again using hydrostatic bearings and self applying probe assemblies were also produced by the British Steel Technical Centre at Corby prior to its closure in 1991.



*Unicorn
URP 350/S*

At that time some of the Engineers involved with the development of rotary heads formed the company known today as Unicorn Automation (NDT) Ltd; this has ensured the continuation of the developments, which now stretch over five decades. Since 1991 Unicorn recognised the need for even faster testing speeds, and have further developed the rotary heads and probe application mechanisms to incorporate many more channels, higher rotational speeds and the ability to now test tubes with uncut or upset ends.

Over the last decade Unicorn have installed their rotary heads in major tube producer plants in various locations around the world. Even today, the development program is on-going with the advent of the next generation of rotary heads which will achieve faster testing speeds, improved maintenance features and even reduced costs.

Unicorn now offer a range of contact shoe rotating heads covering tube diameters from 38mm to 700mm o.d.

Author

C. James

C.Phys., M.Inst. P., M.Inst.NDT