A Precision Quill for the ACIERA F1

J Malcolm Wild describes a classic range of milling machines, focussing on the popular F1, and shows how he made a versatile precision quill for it.

For anyone carrying out accurate milling, there is no more versatile machine than the ACIERA. Many models were manufactured in Switzerland, the smallest, the F1, being the most desirable for precision work in horology, instrumentation and model engineering. ACIERA also produced precision drilling and tapping machines.

History

ACIERA was founded in Le Locle, Switzerland in 1903, with the prime intention of serving the watch making industry. By 1914 it was employing 50 precision engineers but, with a change of management, production had started on universal machines, not only for watch making.

With the passage of time and increasing demand, by 1943 ACIERA, by local standards, had become the largest producer with more than 250 employees. In 1973 a new factory was completed in nearby Le-Crét-du-Locle, with a floor space of 14,000 square metres and 134 new production machines (see rear cover). By this time ACIERA was selling to 60 countries, with the sale of its traditional range of machine tools growing each year.

ACIERA had made its name by manufacturing a range of small to medium sized universal machine tools of the highest precision for use in tool rooms and on the factory floor of industries such as watch and instrument making, electronics and research and development. Products included single and multi spindle drilling and tapping machines, and universal milling machines, with specialised versions for series production.

In 1978, following the death of the owner and managing director Albert Saner, the new management decided to invest in new technology and change from the traditional manually operated machines to electronic and computerised control. In so doing the established and successful basis of the business was changed. It was a step too far; over investment and over expansion with new and untried machines the market was not ready to buy.

In December 1991 ACIERA was taken over by the German group HEMME, a family-owned machine tool concern. Confronted by problems of heavy competition it hoped that buying ACIERA would provide a larger sales base and eliminate important competitors. In spite of early optimism this venture failed and ACIERA was declared bankrupt in February 1992 with total liquidation being completed by the end of 1994. The machines were sold to an Indonesian businessman.

ACIERA Machines

The range of precision millingers was extensive commencing with the F1, 1, which is the smallest and most useful for instrumentation work. The F2 is a very rare machine; ADAM MACHINE EQUIPMENT, which held the ACIERA agency from the early 1950s until 1978, imported only 1 or 2 into the UK. Many F1s and F3s were sold during that time, the F3, 2, being supplied mainly to medium sized engineering companies for tool room work as the versatility of the machine with its many attachments was ideal to cover very varied work. The F2 suffered from a design fault. The ram had not been designed with sufficient strength and suffered from deflection when machining loads were applied.

The largest machine was the F5, which had a 32" x 12" (800 x 300mm) table. The type F4 had a slightly smaller table. As will be seen later, all these machines could be

1. The ACIERA F1 shown on a stand in horizontal mode, with accessories. The vertical attachment is shown above right. (These and subsequent images from contemporary catalogues).

2. The ACIERA F3, right, intended for production work. Shown in vertical mode, with tilting table and tilting machine vice.

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Many famous companies purchased these machines including **Decca**, **Dowty**, **EMI**, **GEC**, **Kodak**, **The Ministry of Defence**, **Rolls Royce**, **Smiths Industries** and many universities.

**The Aciera F1**

The type F12, 3, produced in 1943, was the forerunner of the F1, probably the machine of most interest to HF readers. Production of the F1 commenced around 1950 and it proved to be a very successful design, made to extremely high standards of accuracy and the usual Swiss precision. The main spindle accepts 12 mm collets, the same size used on the Schaublin-70 instrument lathe.

Figure 1 shows the Aciera F1 fitted on its cabinet with the milling head mounted horizontally. An important feature of this machine was the facility to mount the head in both vertical and horizontal modes. When mounted vertically a bracket was supplied with a spigot that fitted the bore in the ram. This accessory, with others, appeared in the mains sales catalogue, 4.

The design of the vertical bracket incorporated the facility to swing the spindle over each way by 45°. A sector portion of the casting was suitably engraved and the bracket pivoted on the spigot that fitted the ram.

Another feature of this machine was that all accessories, adjustable stops and clamps were operated with one single 6 mm Allen key. The 3-jaw self-centring chuck supplied with the machine also had a 6mm socket for operating the jaws in place of the normal square key.

Many F1s were supplied as horizontal machines for production work; these were the F1N and F1H. Automatic feed to the table could also be fitted.

As can be seen, 4, there were many useful accessories available

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3. The Aciera F12 produced in 1943, was the forerunner of the F1.

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supplied with a wide range of accessories including dividing head, rotary table, slotting head, vices, etc. Another useful feature was the facility for both vertical and horizontal machining. The main table could also be tilted.

4. **Accessories for the F1:**
   - a vertical support
   - b universal vertical support
   - c drilling attachment
   - d slotting attachment
   - e plain table
   - f universal table
   - g rotary table
   - h swivel support
   - i rotating vice (a rotating and tilting vice was also available, see 2)
   - j simple dividing head
   - k universal dividing head
   - l simple dividing head with quick clamping device.

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to enable the operator to carry out the most complicated work.

Figure 4f shows the universal table in position. This fits into the swivel support, as do a number of the accessories. The table tilts forwards and backwards 30°. It also tilts from left to right as well as being able to rotate in the horizontal plane. Also available was a plain slotted table, 4e, together with a centering microscope mounted in the main spindle, 5. The dividing head, 4k, mounted vertically, 6, allowed direct indexing from both notched plates and from worm and wheel. With the accessory mounted in this position it is possible to drill on a PCD and carry out similar work. As with the main F1 spindle, the dividing head accepts 12mm collets and the nose is threaded 22.6x2mm as is the SCHAUMLIN-70 instrument lathe. This enables work to be transferred from one machine to the other while maintaining concentricity.

Figure 7 demonstrates machining a 12-leaf pinion, the dividing head and main spindle are both mounted in the horizontal position.

Two types of precision vice were available, both rotating, 4i and 2. One had tilting facility enabling work to be angled through 90°. Figure 1 shows the angled vice in position mounted on the universal table. Work is being machined using an end mill held by a collet mounted in the vertical spindle.

The rotary table, 4g, does not have the normal design of worm and wheel to rotate the table. The rotary movement is with a handle and angular motion is controlled by adjustable stops mounted in slots on the edge of the main table. A slitting head, 4d, is a useful accessory. This one is quite robust but the stroke is limited to just 10 mm.

Having used the machine for three years or more, there appeared to be one major disadvantage. This was that there had never been a vertical quill supplied with the machine. The main sales catalogue illustrates a unit described as a drilling unit, which accepted 8mm collets, not the 12mm size used on the machine. According to ADAM MACHINE EQUIPMENT's records, none of these units were ever supplied.
A Quill for the ACIERA F1

Realising what a great advantage it would be to have this extremely versatile machine fitted with a quill, a design project was launched. The criteria were to have a unit that looked as if it had been designed for the machine with a high-speed spindle accepting the standard 12mm collets. The design was loosely based on the BRIDGEPORT vertical head with lever feed on the right hand side and worm and wheel feed on the left hand side. An adjustable stop and spindle clamp was also fitted.

While the original motor had a direct belt drive to the gearbox and spindle, the drive was direct from a 110 volt DC motor with three-step pulley direct to the work spindle. A PENTA POWER DC unit controlled the motor giving variable speed.

Once the design had been finalised work was commenced on patterns. Two were required, one for the main casting and a small guard pattern for the worm and wheel housing. Figures 8 and 9 show the finished quill. My intention was to make one unit for myself, but while work was progressing other owners of ACIERA F1s expressed interest in having a quill. Five units were made initially, followed by another five.

Figure 10 shows one of the steps in machining the main casting. The bore was honed to suit the spindle body. Each unit was individually matched. The design of this quill spindle, 11, was fairly conven-

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by the author.
13. A high resolution (0.005mm) ACURITE digital readout system was fitted to Y and X axes of the ACIERA F1.

14. Re-cutting jewel seatings in a pocket watch plate is an example of the delicate, precise, work which can be carried out with the new quill.

itional; two pre-loaded bearings were used. These were combined needle and angular contact, which gave excellent lateral and axial thrust and kept the overall spindle and casting compact. Maximum speed was restricted to 5000rpm but the maximum design speed for the bearings was 9000rpm. All gear cutting was carried out by specialists.

The lever feed, 8, was calculated to give a sensitive feed; provision was also made for variation in the handle position. It will be seen that there is a knurled knob on the outside of the handle boss. When releasing there is a dowel pin in the handle boss which can locate in one of six positions to give the most comfortable working position depending on where the quill nose is situated. A quill-locking clamp is also fitted. Quill feed is 40mm. Note the adjustable depth stop, 8. A MITUTOYO digital scale enables depth to be accurately measured. Facilities for zeroing and switching from metric to imperial are included. With the original F1 head, the working height from the table is restricted when, say, a drill chuck is fitted; this design has been lifted 20mm to give more working space.

At the opposite end of the down feed spindle is the worm and wheel box, 12. the ratio, 60/1, gives a sensitive feed for fine work; for example boring and counter-boring. Among the components, is a mainspring barrel, which houses a conventional clock spring. The barrel can be set to give the required adjustment for balancing the quill. A dog clutch enables either the lever or worm to be selected. Where possible, saving considerable time, items with unusual and difficult shapes were cut by wire erosion (EDM).

Many problems were encountered but they were eventually overcome. When the main spindle was assembled, normal bearing grease was used but this was totally unsatisfactory. The bearing manufacturers were contacted and were most helpful, suggesting KLUBER Isoflex LDS18 Special A. This proved to be an excellent light bearing grease.

The original vertical bracket had the degree scale engraved into the casting itself. Due to the configuration of the casting, it was necessary to have the scale engraved on brass, 9, and bonded to the casting. All engraved components were satin chromed on the original machine; this process seems to be discontinued in most plating shops so the scale was satin nickel-plated, which produced a very close match.

As previously stated, the quill accepts the standard W12 collets. A precision drill chuck is also necessary. Two chucks, of different capacity, are used. Both are ALBRECHT Keyless, the smaller 0–1.5mm and the larger 0–6mm. These are extremely accurate chucks. With the new quill it is possible to drill a 0.2mm (.008") hole in steel using the extremely sensitive handle feed.

Digital read-out was fitted to the 'X' and 'Y' axis to give accurate positioning of the table. The unit was manufactured by ACURITE, who supply miniature scales that are ideal for this machine. The scale for the 'X' axis tucks very neatly away behind the slide. High-resolution scales were fitted; these were more expensive but gave accuracy of 0.005mm (.000025)

Figure 14 show an example of the delicate work which can be carried out.

The new quill unit, with the addition of digital read-out and the facility of a drilling and boring quill, transforms the ACIERA F1 into a very versatile machine that is more than capable of fine jig boring and light milling. Over the years I have attempted without success to find a HAUSER jig borer, however the F1 with all its accessories and the new quill has proved to be a far more useful machine. The design and manufacture of a unit such as this gave me many sleepless nights; it is very difficult to achieve a faultless design first time. With hindsight, it would have been better to make one unit only and iron out all the problems, but in the end the quill, as made, gives excellent results.

Acknowledgments

L JAINLOCH, Sales Director (now retired) of ADAM MACHINE EQUIPMENT LTD, sole UK agents and importers of the ACIERA machines 1954-1978.