DK 803 - THE NEW DIMENSION IN CARDS

Dr. Stefan Schlichter, Dipl.-Ing. F. Leifeld
Truetzschler GmbH & Co. KG
Moenchengladbach, Germany

Abstract

The development of the new Trützschler DK 803 high-performance card represents a new approach in significantly boosting card production whilst maintaining high quality.

The analysis of the functional elements of a high-performance cards demonstrates that improved preopening before the cylinder can positively influence this important carding point in the card to such an extent that the intensive carding necessary for high output is facilitated by high cylinder speeds, finer wires and shorter distance between functional elements without having a negative impact on carding quality. The DK 803 therefore has a preopening unit consisting of three licker-in as well as a new feed system with individual clamping and sensing. Tuft feed is integrated in the card.

Novel auxiliary equipment for achieving high carding quality, such as the contact-free FLATCONTROL FCT flat distance measuring system and the integrated NEPCONTROL NCT on-line nep sensor have been developed to enhance the card's benefit to the user.

Practical results from the use of the new card prove that the DK 803 can be sensibly employed both to improve quality and to raise output.

Efficiency calculations demonstrate that the user has at his disposal a new card which dramatically improves the economic utility of carding.

Introduction

The card is still the key machine in the spinning process when it is a question of achieving high quality. It is in this machine that the most important characteristic data of significance to quality in the subsequent spinning process are established.

Although in the last few years most attention has been focused on improving the standard of quality of the produced card sliver with high raw material flexibility and a wider range of materials, the achievement of high machine output is now becoming increasingly important. This is attributable above all to the strong international competition between the spinning mills which forces individual mills to constantly adapt the efficiency of their production to the conditions of tougher international competition. The increase in output expected by the market may not of course be achieved at the expense of quality. In fact further improvements in quality are desired in virtually all market segments in order to secure further economic advantages, amongst other things through a better exploitation of raw materials.

For the developer of new high-performance cards, this situation appears to become an utterly insoluble conflict. If one nevertheless accepts the challenge and looks systematically for ways of solving this problem, an in-depth analysis of the working of all the elements of a card does in fact reveal a way of meeting these two apparently contradictory requirements. This paper is reporting on such an approach which has already been realized in the form of the new Trützschler DK 803 high-performance card.

The DK 803 High-Performance Card

The DK 803 card is a new development which for carding represents a step forward bigger than any other achieved in a development phase in this century. This statement is justified by the increase in output alone achieved by the DK 803 with unchanged technological values. This can be seen from the production characteristic over time (Fig. 1). The top line shows maximum output, as represented, for instance, by rotor spinning. The bottom line refers to high ring spinning and combing qualities. The magnitude of this step forward becomes even clearer when the increases in maximum output over a period of five years are compared with each other (Fig. 2). These conclusions are based on the fact that the compared production levels are attained with identical carding results. With the DK 803, quality can be improved in terms of card sliver or in the subsequent process if the production level is maintained.

An in-depth analysis of the working of various elements of the card reveals that the "flat/cylinder" area represents by far the most effective part of the card in terms of cleaning, nep reduction, short fibre removal and fibre alignment. All of the other functional areas of the card are significantly inferior in their effect and are only of significance in conjunction with the "flat/cylinder" carding system. Consequently, if the card is to be optimized further, it is precisely this area which demands maximum attention. The decisive factors in terms of quality and performance here are:

- Cylinder speed
- Wire fineness and form
- Distance between cylinder and flat

If the above-mentioned settings are modified to achieve higher output in terms of more intensive carding, one must regrettably discover that beyond certain limits this leads to an unacceptable deterioration in the fibre values. The limits are imposed by the state of preparation of the material in

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the carding area and, in particular, by the degree of opening and the quantity of material supplied to the carding elements. An improvement in this situation can therefore only be achieved if the preparation of the material is improved before it reaches the "flat/cylinder" configuration, the most important carding area. The measures described in the following, which are aimed at presenting an pre-opened web to the cylinder instead of small tufts, pursue this main goal.

The experience gained in opener and cleaner development together with a correctly graduated opening sequence has been consistently applied to the card. Balanced with the already optimized degree of opening, as already manifested in the modern cleaners of the CVT family, further mutually adapted opening and levelling elements have been incorporated between the licker-in and cylinder. These elements are two additional opening rollers which also eliminate dirt, dust and short fibres to some extent. Instead of one licker-in, the DK 803 thus has three rollers in series of which the first is a fully spiked roller (Fig. 3). This ends up in extremely gentle opening and an extremely long wire life as far as this roller is concerned.

The fibres therefore reach the cylinder in the form of a uniformly thin web after being efficiently opened by a series of three rollers with progressively finer clothing and running at progressively higher speeds. Fig. 4 shows how the licker-in has been adapted to the cylinder in terms of circumferential speed, wire fineness and working angle. The flow of uniform and fine fibres ensured in this way now permits finer wires, closer settings and higher cylinder speeds without the conventionally associated disadvantages. This measure alone has therefore shifted the limits upwards.

The new WEBFEED precarding unit is the most striking and important change on the new DK 803 card. Unlike the earlier multiple licker-in versions, which were principally aimed at achieving greater cleaning efficiency, the emphasis on the DK 803 is carefully targeted and properly graduated opening and thus an improvement in the carding conditions on the cylinder.

Upstream from the WEBFEED further newly developed components help to improve carding results. Improved uniformity across the working width and over time is achieved by the novel DIRECTFEED system. The bottom trunk of the integrated tuft feeder terminates directly in the feed unit which is positioned upstream from the licker-in (Fig. 5). The transfer table is thus eliminated. Automatic piecing thus becomes possible at this point.

Immediately behind the feed table, the material is clamped on a series of plate springs and held against beating action of the licker-in (Fig. 6 and 7). At the same time material thickness is sensitively scanned in 10 sections by the row of plate springs. With this SENSOFEED feed unit, novel use is made of the pedal feed principle with the advantage of individual sectional clamping and measurement.

The measurement necessary for infeed control takes place directly in the opening zone. This simplifies and improves control behaviour and hence uniformity as well. The uniformity of feed thereby achieved has a positive effect on the working of the WEBFEED and the cylinder and ultimately on the uniformity of the card sliver.

High output can be achieved by means of coarse sliver counts or high delivery speeds. It should be noted in this context that the lower the sliver count, the lower the loading of the rollers, which yields superior carding results. For this reason a high delivery speed is desirable.

However, this process has to be technically controlled. Recently developed web guide elements in the doffing zone and a separate drive (SERVOSPEED) in the web doffing zone, which automatically adjusts draft relative to speed, solves the problem (Fig. 8). This development enables delivery speeds in the 300-400 m/min range, depending on the material.

The great importance of the design and accuracy of the functional elements in the carding zones around the cylinder has led to the further development of the elements familiar from the DK 760. Specially for the DK 803, new wire forms and finenesses have been developed which further optimize carding results. The wires made of special, high-alloy steels help to maintain carding results over a long period. This measure combined with the already mentioned improvement in preopening by the WEBFEED has considerably extended wire life time, a fact already confirmed by the first practical applications of the machine. In addition the necessary service work on the wires has been minimized, which overall has considerably reduced stoppages at the machine. This is an essential requirement of a high-performance machine like the DK 803.

In addition to the wires it is important to mention the following elements which also contribute to the success of precise and reproducible carding:

* high-precision rigid revolving flats made ofextruded aluminium profiles
* high-precision all-steel cylinders produced onspecial machines, and
* all peripheral elements for covering, extraction and carding made of precision-extruded aluminium profiles.

In order to take account of the great importance of setting accuracy for carding results and the problems which always face the setter however careful he may be, we have developed for the card a flat measuring unit which, with the cylinder running, electronically measures the distance between the cylinder and flat wire at two points on the cylinder and throughout the carding zone (Fig. 9). The values recorded on-line are graphically indicated or printed.

Now that settings can be achieved with a degree of accuracy so far unknown from manuel setting.The new FLAT CONTROL FCT flat gap measuring unit is an important contribution to improving carding quality.

To obtain the very best technological values and to guarantee them in practical operation over the long term, the on-line recording and evaluation of the most important quality data is essential. Displays on the card and in KIT (Fig. 10) keep the user constantly informed of the operating status, production values and the quality achieved. Deviations from the setpoints are immediately registered and give rise to warning messages or to the stoppage of the machine.

In addition to regularity values, the spinner has generally always been interested in the number of neps remaining in the card sliver. To be more precise he wishes to know how many fibre neps and how many foreign particles are present in the card sliver. This is a way of precisely defining carding results.

In this connection a breakthrough has been achieved with the development of a new on-line nep sensor. A nep and foreign particle sensor, which optically senses the running card web between take-off roller and squeeze rollers, can be incorporated in DK 803 (Fig. 11). This is the only point at which the web is free from rollers and wire points and allows the card web to be monitored and measured without difficulty. In this zone the web passes over a guide profile which contains a glass-covered observation slit. Below it is located a miniaturized, carriage-mounted electronic camera and illumination unit. Motor-driven, the camera traverses the working width.

Photographs are taken continuously during production and the images are analyzed. It is then possible to distinguish between fibre neps and foreign particles like trash particles and seed coat fragments. The number and size of particles and neps can be determined and evaluated. In this way histograms can be produced which provide precise knowledge of the particles in the card sliver. Five pictures are analyzed per second. Nep distribution over time and across the cylinder width is presented graphically. Values can be displayed on the card monitor and stored in KIT, which is an important factor in long-term trend monitoring.

In this way precise conclusions can be drawn as to the condition of the wire - in terms of location and time - and as to flat setting and changes in the material used. With the NEPCONTROL NCT nep sensor, important quality data, which can otherwise only be obtained at great expense in the laboratory in random sample form, is now available on-line for the first time.

As an example, Fig. 12 shows the foreign particle curve from a DK 803 high-performance card evaluated with the NEPCONTROL NCT nep sensor in which the raw-material-related fluctuations in particles are presented over time.

Practical Experience with the DK 803

The DK 803 (Fig. 13) has already proved its capabilities in practical use. Production level and carding quality have been the core factors of the study. The machine was used in ring and open-end spinning mills. The end results are, as ever, dependent on the material and the process and we are therefore only able to quote sample results here.

The following graphs show results from an open-end cotton spinning mill in which the DK 803 has been integrated in an existing carding installation. The DK 803 was operated here at 50% and 90% higher output over a period of several months. At regular intervals comparative final spinning was carried out in order to permit an assessment of the effect of the new machine on ultimate yarn quality.

The values for residual trash in the card sliver presented in Fig. 14 demonstrate that even with production boosted by 50% a considerably better degree of cleaning has been achieved which even with production almost twice as high as that of the reference machine is still easy to identify. This effect is even more apparent in the yarn, which can be seen from the IPI values of the yarn given in Fig. 15.

An important conclusion can be drawn from the next graph (Fig. 16) in which yarn strength and elongation are presented. The high output of the DK 803 has no negative impact on the dynamometric yarn values, which shows that the gentle opening of the material by the WEBFEED of the DK 803 facilitates high output without unnecessarily stressing the fibres.

The values given here as examples have been confirmed in numerous practical applications of the new card. An evaluation summing up all the results available to us so far clearly illustrates that the new card obtains carding results which are far less dependent on the rate of output. It was well-known from existing cards that increases in output were always associated with a decrease in quality which became particularly apparent at peak production levels. With the DK 803, however, this drop in quality is far less abrupt and at a higher level of quality. As far as neps and strength are concerned this is clearly indicated by Fig. 17 showing the curves of carding quality from conventional high-performance cards compared with the DK 803. The user can thus benefit both from an increase in output and from an improvement in quality.

Cost Effectiveness

The new high-performance DK 803 card was developed to give spinners a means of achieving extremely high-quality production with greater cost-effectiveness than is possible with conventional high-performance cards. This is documented by reference to the next example of an application in a US open-end spinning mill. As the breakdown of the costs in Fig. 18 shows, the high output of the DK 803 yields cost reductions in all areas and makes the machine a highly attractive investment for many spinning mills.

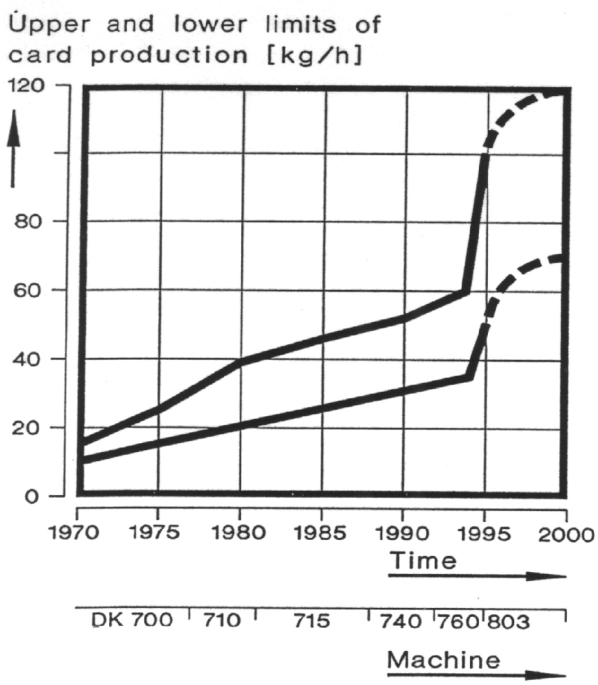

Fig. 1. Card production between 1970 and 2000

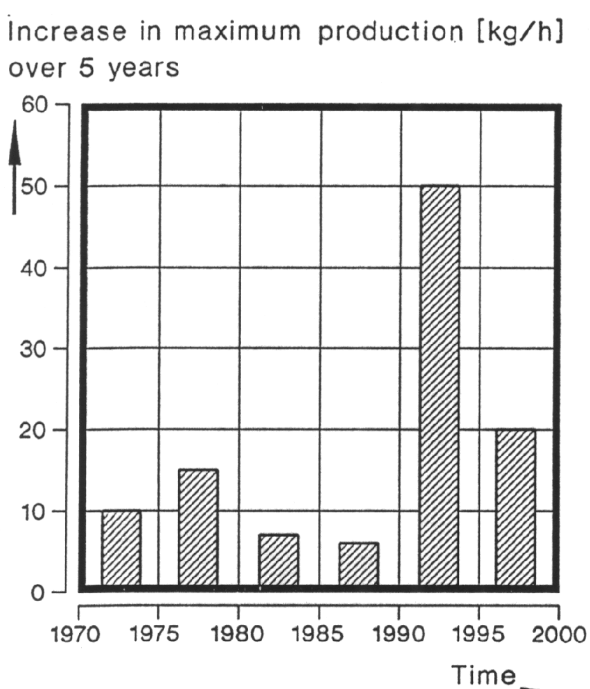

Fig. 2. Card production increase between 1970 and 2000

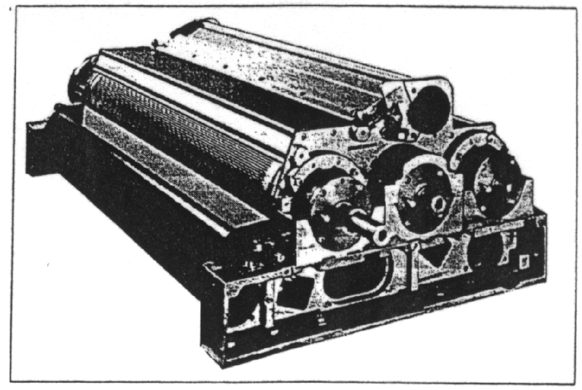

Fig. 3. Three licker-in system WEBFEED

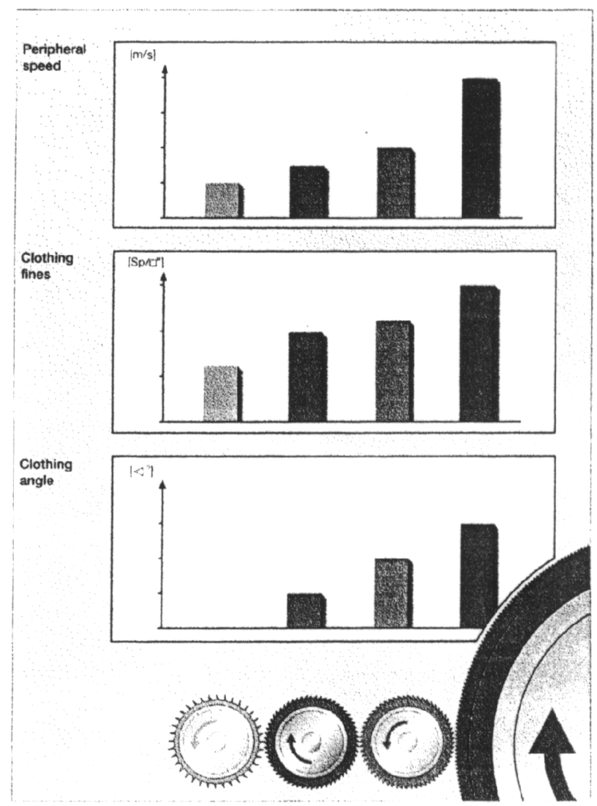

Fig. 4. Gradual gentle fibre opening

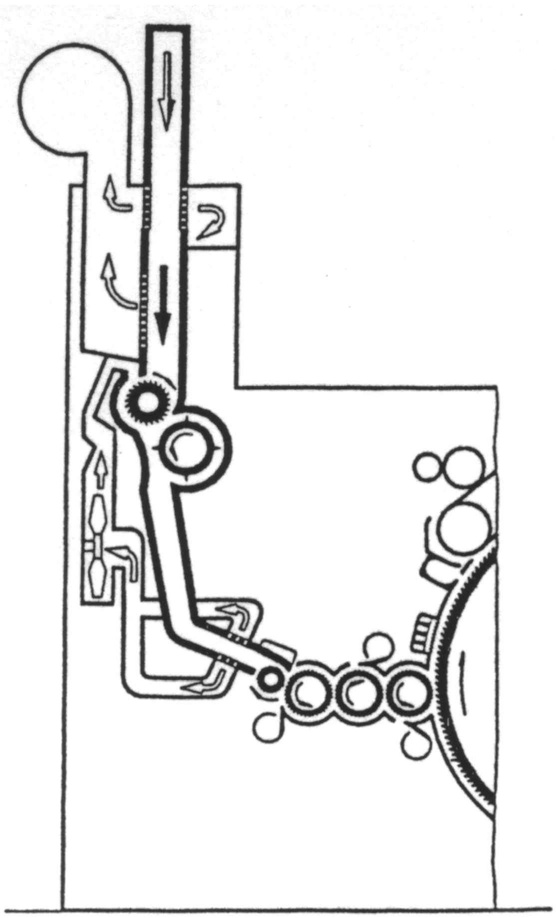

Fig. 5 Feeding system DK 803

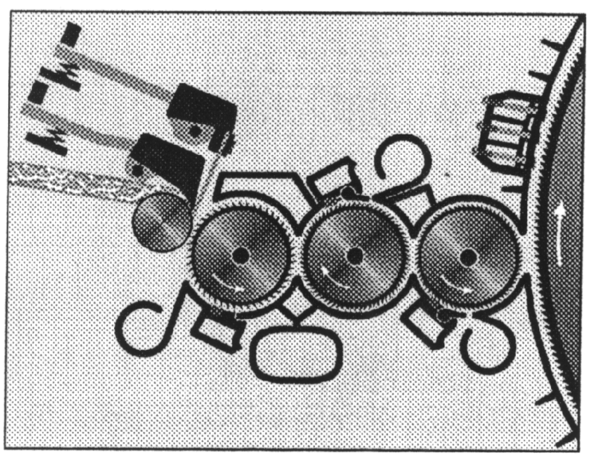

Fig. 6. Feed table arrangement DK 803

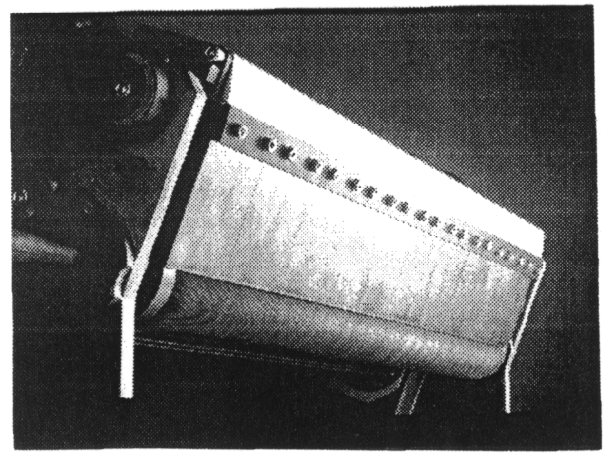

Fig. 7. Card feed unit SENSOFEED

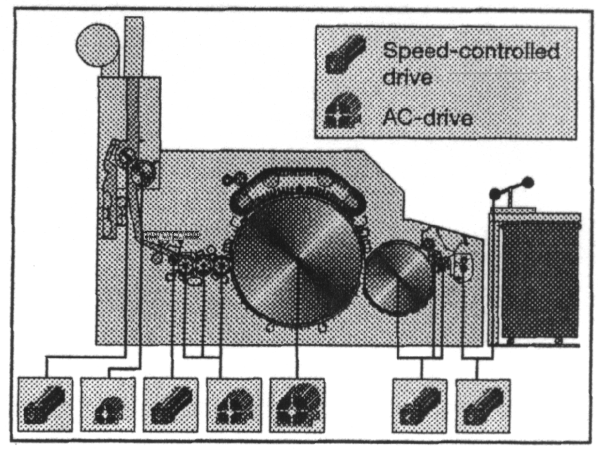

Fig. 8. Drive system DK 803

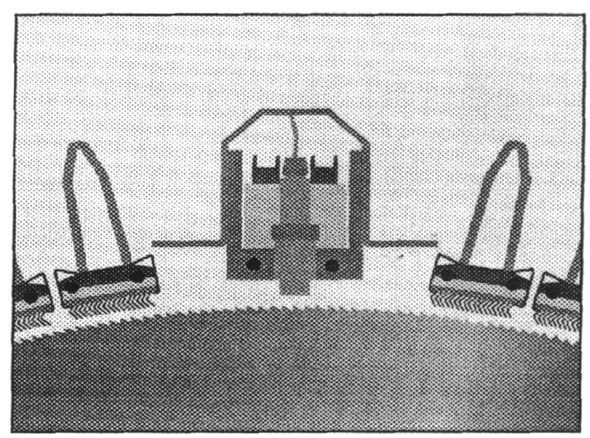

Fig. 9. Flat measuring system FLATCONTROL FCT

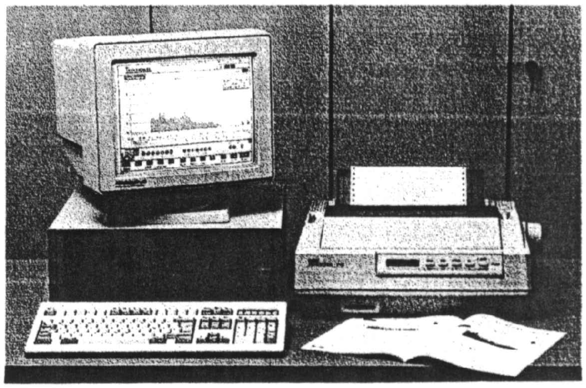

Fig. 10. Sliver information sytem KIT

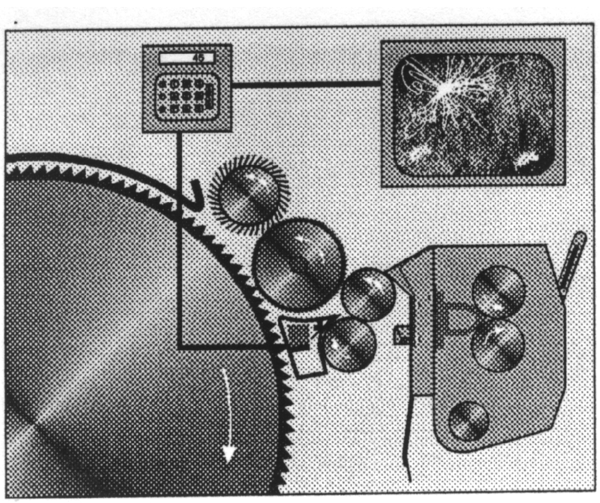

Fig. 11. Nep sensor NEPCONTROL NCT

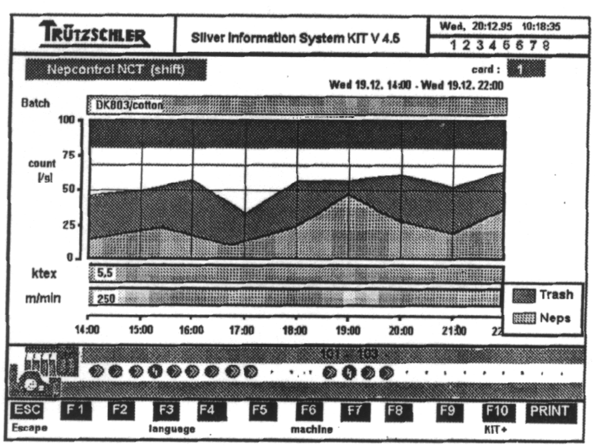

Fig. 12. Nep levels of ~~DK 803 (measured by~~ NEPCONTROL NCT)

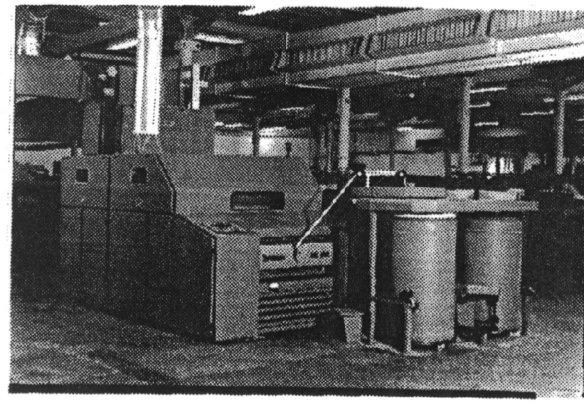

Fig. 13. High production card DK 803

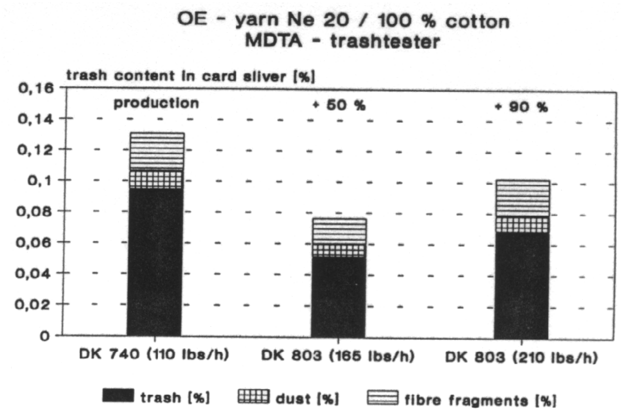

Fig. 14. Trash content in card sliver

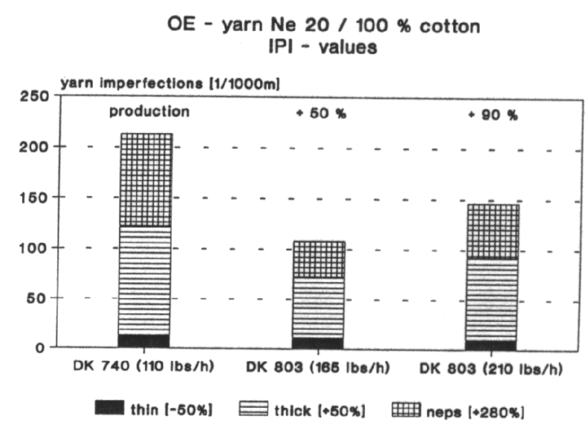

Fig. 15. IPI-values of OE-yarns

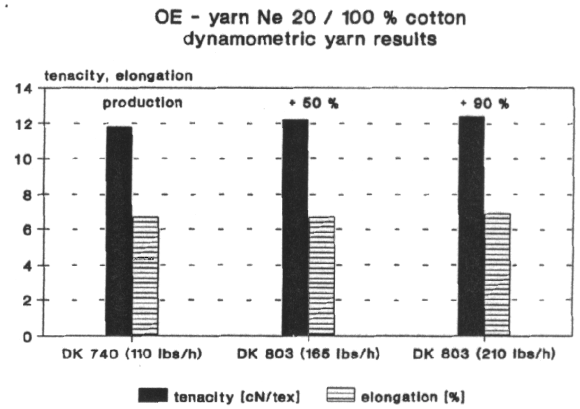

Fig. 16. Dynamometric yarn results of OE-yarns

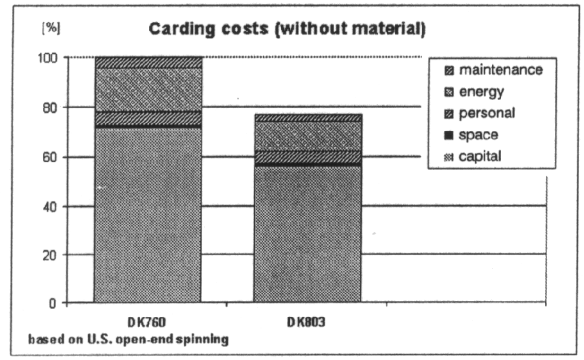

Fig. 18. Carding costs of DK 803 versus DK 760

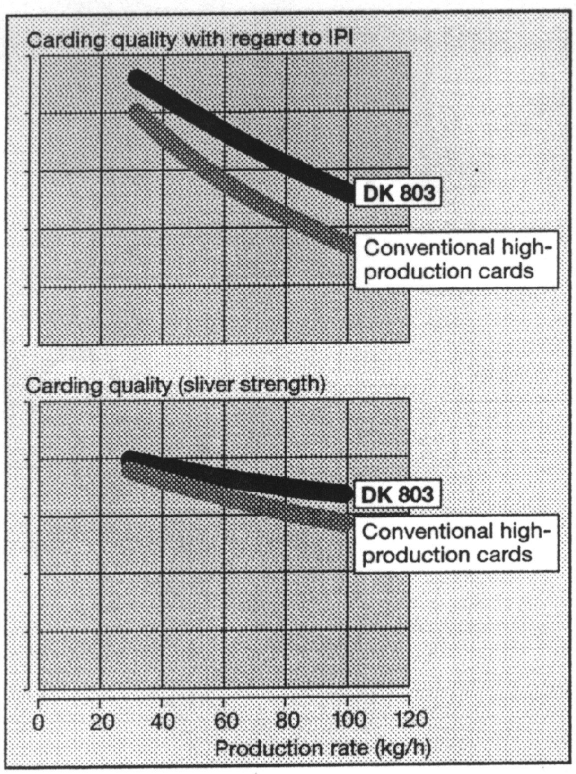

Fig 17. Carding quality of DK 803 versus conventional high production cards