1. Introduction

Accompanied with the diversification of cloth materials such as woven, knitted and laminated fabrics, endeavour has been made to modify the shape of sewing needles, cloth feeding mechanism and so on. Thus, thirty kinds of stitch patterns are established by JIS (Japan Industrial Standards), but only DA x 1 needle for LS 1, DB x 1 for LS 2 and DC x 1 for EF 4 are standardized as needles for industrial purposes.

For conventional sewing L 12 machines, a) thread take-up lever, b) needle bar, c) shuttle body, and d) feed dog are driven by means of a cam, link and piston-crank mechanism to form one stitch in one revolution of an arm shaft.

The formation of stitches are influenced by such factors as mechanical properties of cloths and sewing threads, shapes and sizes of needles and feed dogs, presser bar pressure and quality of presser feet. So, an instrument convenient for evaluating these factors relevant to the so-called sewability is highly desirable.

To meet such needs, Iwamoto Seisakusho Co., Ltd. developed an instrument for measuring the cloth penetrating behavior of needles. In the followings, we introduce general outline and experimental results from the standpoint of a user as well as of the producer.

2. Instrument Outline

The instrument is designed so as to i) measure the cloth penetrating and withdrawing force, ii) observe the cloth deformation during penetration.

In order to conduct the above stated observation ii), the instrument is so constructed that the typical sewing machine is set up side down. For the measurement of penetrating force of i), needle (7) is fixed at pin holder (8) tied by a screw to the upper end of the round needle rod which is supported with slide bearing (9) so that the force along the needle axis can be detected by load cell (10). The load cell is attached to crosshead (11), after adjusting the needle point to coincide with the center of the throat plate hole.

The displacement of the cross head, and of the needle point can be detected by the resistance change of linear potentiometer (12).

Since the penetrating force is influenced by applied pressure, there is equipped with a balance on the upper base (19). First, removing adjusting weight (1), balance weight (16) and a fine adjusting screw on the left end of the balance are set to get the equilibrium of the balance. The applied pressure required is then obtained by moving weight (1).

By lifting the right arm of the balance, a specimen, narrower than 50 mm, is put between circular presser foot (6) and circular throat plate (4). In order to measure the penetrating force when cloths are under tension, specimens, longer than 500 mm and narrower than 50 mm, are pulled with dead weight (22) through roller (20).

Fig. 1 Mechanical parts of the device
For observing the cloth penetrating behavior of needles, the throat plate is made of transparent acrylic polymer. A medical Nikkor lens having long focal length is installed together with a ring type xenon tube to record the pictures even at the magnification of 2 and at the distance of 106 mm.

The front view of the device, 346 mm deep, is depicted in Fig. 2.

A circuit diagram and an example of recorded results are shown in Fig. 3, the circled numbers in which are identical to those in Fig. 1.

The resistance during the cloth penetration of needle (7) is measured by load cell (10), which is arranged by 4 gauge method. The needle displacement is measured by a linear potentiometer (12) which is connected to terminals of a recorder. The device is run at 0.2-4 rpm to avoid the gyrational influence. At the bottom of Fig. 3, is shown a DB × 1 needle on which numbers 1–6 are labelled to show the phase of the observed curves during cloth penetration.

In Figs. 4 and 5, are shown some examples at low penetrating force using a DB × 1 No. 11 J needle. As a 2-pen type recorder available in the market is slow in speed of paper feeding, a X-Y recorder has an advantage over the former for analysing the observed data.

Figure 6 represents an example of penetrating behavior of the same cloth as of Figs. 4 and 5. A DB × 1 No. 11 B needle is withdrawn soon after the maximum penetrating force is obtained. The black square marked initially on the cloth specimen is 5 × 5 mm. The white point near the center of the throat plate hole is the needle point, and the dark part surrounding it represents the stitch hole of the cloth.
3. Specifications

The standard specifications are as follows:
1) Specimen dimension
   Width < 50 mm,
   Length > 200 mm,
   Thickness < 3 mm
   under pressure

2) Needle
   No. 8–No. 18

3) Revolution
   0.2–4 rpm

4) Pressure
   0.3–5 kg

5) Cloth stretching force
   up to 3 kg

6) Maximum penetrating force
   5 kg

7) Diameter of throat plate
   hole
   ø1.4, 1.6, 1.8, 2.0, 2.2

8) Recorder
   X-Y recorder

9) Display of needle
   displacement
   Analogue

10) Length of crank and
    connecting rod
    R: 15 mm, L: 50 mm
    (See Fig. 1)

4. Conclusion

Iwamoto Seisakusho Co., Ltd. has a pleasure to introduce

Fig. 6 Recorded example of cloth penetrating behavior:
(weight: 70 g/m², thickness: 0.14 mm, needle: DB x 1 No. 11 B.)

first in the history the instrument to measure the sewability
of clothes. She is now also trying to develop some instru-
ments to measure penetrating force at high speed and to
analyze cloth feeding mechanism.