“十一五”国家重点图书

Springer 纺织百科全书

R－Z

（注释本）

［德］Hans-Karl Rouette 著

中国纺织出版社专业辞书出版中心 译

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Translation from the English language edition:
Encyclopedia of Textile Finishing by Hans-Karl Rouette

著作权合同登记号：图字：01–2006–3234 号

图书在版编目(CIP)数据

Springer 纺织百科全书：注释本／（德）鲁埃特 (Rouette, H.K.) 著；中国纺织出版社专业辞书出版中心译 .—北京：中国纺织出版社，2008. 5
ISBN 978–7–5064–4714–0

I. S… II. ① 鲁… ②中… III. 纺织工业—百科全书—英、汉 IV. TS1–61

中国版本图书馆 CIP 数据核字(2007)第 173757 号

策划编辑：李陵申　郑　群　刘波涛　唐小兰
责任编辑：刘波涛　于磊岚　唐小兰　陈静杰
责任校对：俞坚沁　责任设计：何　建　责任印制：刘　强

中国纺织出版社出版发行
地址：北京东直门南大街 6 号　邮政编码：100027
邮购电话：010—64168110　传真：010—64168231
http: //www.c- textilep. com
E-mail: faxing@c-textilep. com
北京盛通印刷股份有限公司印刷装订　各地新华书店经销
2008 年 5 月第 1 版第 1 次印刷
开本：787 × 1092　1/16　印张：181
字数：8880 千字　定价：998.00 元(全套)

广告经营许可证登记号：京东工商广字第 0372 号

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R

① **R** (formula residue), used in chemical formulas as abbreviation for "residue" e.g. residual fatty acid with a simple or branched (hydrocarbon) chain.

② **ºR** Degrees → Rankine.

③ **RA** → Ramie → Textile fibre symbols, according to DIN 60 001 T4/08.91.

④ **Ra,**

I. → Ramie, → Textile fibre symbols, according to DIN 60 001 until 1988; → RA.

II. Element symbol for radium (88).

⑤ **Rabbit hair** →: Hare and rabbit fibres; Angora.

⑥ **Racemates** (racemic compounds). Lat. acidum racemicum (grape acid), where this phenomenon was first investigated. They occur in chemical reactions in which optically active compounds are involved, by releasing and re-linking bonds. So-called racemates or racemic mixtures are produced from sterically unique compounds (dextrorotatory or laevo-rotary) as mixtures of both types. → Optical Activity.

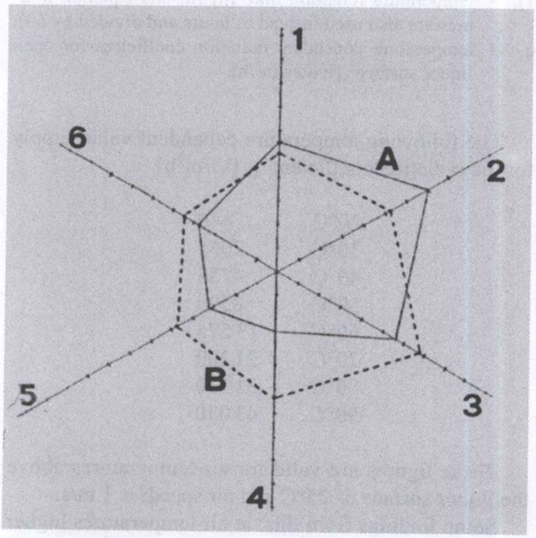


Fig. 1: Radar diagram showing the assessment of handle (as by Kawabata) of a material made from super-microfibres, both in the raw state (A) and following treatment with alkali. 1 = stiffness (koshi); 2 = poor fall (hari); 3 = body and softness (fukurami); springy elasticity (shari); 5 = silkiness (kishimi).

⑦ **Radar diagrams** Used for depicting handle, determined on 6 axes using the → Kawabata system, for example. Fig. 1 shows a Radar diagram comparing the handle of a rough and of a finished fabric. Although there is a reduction in the stiffness value (hari/koshi), there is an increase in flexibility, handle (shinayakasa), volume and softness (fukurami) and elasticity (shari).

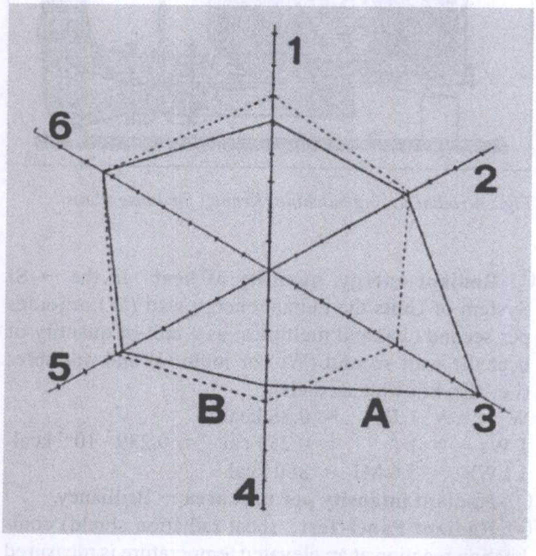


Fig. 2: Radar diagram of a super-microfibre fabric (A) and a silk fabric (B). 1–5 see Fig. 1; 6 = elasticity (shinayasaka).

Fig. 2 shows a Radar diagram comparing the handle of a super-microfibre fabric to that of a silk fabric. It is assumed that the elasticity of the super-microfibre fabric is less than that of the silk fabric; however, the fullness and softness are much better, whereas both the stiffness and flexibility with a soft handle are almost the same.

⑧ **Radial** Radiating from the centre (of a circle) to the periphery; e.g. the horizontal radial section of the → Flax stem structure.

①基团（分子式中）
②兰金温标
③苎麻
④
I. 苎麻
II. 镭的化学元素符号
⑤兔毛
⑥外消旋化合物
⑦雷达图

图 1：评估超细纤维织物原料状态（A）和经碱处理后手感的雷达图

图 2：超细纤维织物（A）和丝织物（B）的雷达图

⑧放射状的

① 径向染色机

图：
散纤维用径向染色机

② 热辐射能
③ 单位面积辐射强度
④ 辐射板式测试法
⑤ 辐射
⑥ 不同类型辐射比较

表：
辐射类型比较

⑦ 染液和染色机的辐射热损失

① **Radial dyeing machine** Packing system dyeing machine with circulating liquor. Either (older version) as round dyeing machine made from cast iron for dyeing hank yarn or made from stainless, acid-resistant steel with liquor recirculation (see Fig.). Usually heated indirectly by steam. The material block is lifted after dyeing on the material carrying plate and is spun in a conventional centrifuge, the upper rim of which can be removed. This kind of special centrifuge is no longer in use, since a normal centrifuge can be used after a batch has been dyed in the radial dyeing machine. This includes other batches such as piece goods, hanks, bobbins. Radial dyeing machines are also used for dyeing wool, cotton, viscose, polyamide, acetate, polyacryl nitrile, hair and rags.

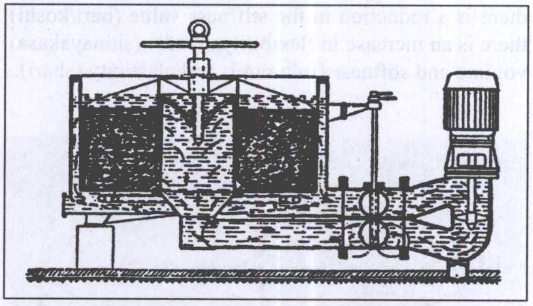


Fig.: A radial dyeing machine (Krantz) for loose fibres.

② **Radiant energy, quantity of heat** In the → SI System of Units the radiant energy watt (W) or joules per second (J/s) and multiples; as a unit of quantity of heat the watt second (Ws) or joule (J) and multiples (i.e. also kilowatt seconds).

W = 1 J/s = 0.86 kcal/h
1 Ws = 1 J = 0.239 cal = $0.239 \cdot 10^{-3}$ kcal
1 kWh = 3.6 MJ = 860 kcal

③ **Radiant intensity per unit area** → Brilliancy.

④ **Radiant-Panel-Test** (heat radiation shield) combustion reaction at an elevated temperature is measured by subjecting a horizontal sample to heat and burning it. The minimum heat flux at which the carpet starts to burn is assessed.

⑤ **Radiation** One differentiates between wave radiation (e.g. electromagnetic radiation) and particle radiation (e.g. radioactive radiation); →: Light wavelengths; Radiation, comparison of different types. For textile applications, e.g. in drying or measuring and control technology, different types of radiation are utilized, e.g. →: Infrared; Microwaves; Radioactive emission; Ultraviolet radiation.

⑥ **Radiation, comparison of different types** Energy rich or ionizing → Radiation (see Tab.) from a few kiloelectron volts keV to a few megaelectron volts

radiation type character	type of radiation	energy	wavelength
electo-magnetic radiation	infra-red	0.01-1.6 eV	780-1000 nm
	visible light	1.6-3.3 eV	380-780 nm
	ultra-violet	3.3-6.2 eV	200-380 nm
	vacuum ultra-violet	6.2-310 eV	4-200 nm
	X-radiation	keV-MeV	<100 nm
	γ radiation	keV-MeV	<100 nm
corpuscular radiation	α radiation	1-10 MeV	—
	β radiation (electron radiation)	keV-3 Mev	—
	accelerated electrons	0.25;15 Mev	
	neutrons (^{1}n)	1 to a few MeV	—

Tab.: Comparison of radiation types.

MeV is of interest for radiation chemical applications (electronvolt definition: 1 eV is the energy which an electron possesses, if the potential energy of 1 Volt passes through it).

⑦ **Radiation heat losses from dye liquors and dyeing machines** Radiation and evaporation at open liquor surfaces:

equation for the calculation of heat loss:

$$Q_2\,[\text{Joule}] = q_2 \frac{[\text{Joule}]}{[\text{m}^2]\,[\text{h}]} \cdot F_2\,[\text{m}^2] \cdot T_H\,[\text{h}]$$

Q_2 = radiation and evaporation losses [joules],
F_2 = radiating open liquor surface [m^2],
T_H = temperature retention time [h] (in this equation minutes are also used instead of hours and divided by 60),
q_2 = temperature dependent radiation coefficient for open liquor surfaces [joules/m^2/h].

The following temperature dependent values apply for the radiation coefficient q_2 [kJ/m^{2}h]:

20°C	440
30°C	2055
40°C	4735
50°C	8590
60°C	13 575
70°C	21 200
80°C	31 720
90°C	43 030

These figures are valid for air temperatures above the liquor surface of 25°C and air speeds < 1 m/s.

Some findings from this: at air temperatures higher than 25°C, which almost always prevail in the layers of air above the liquor surface, e.g. in preparation and overflow vessels, due to heat radiation, the air humidity absorption power is correspondingly higher, which equates to higher evaporation losses. The same also applies if a stronger air flow carries away the moisture saturated air in the overflow vessel. These influence variables have been disregarded here. However, comparing the radiation values of q_1 with q_2 for uninsulated vessel surfaces, then one finds that open liquor surfaces that are not absolutely necessary must be eliminated for reasons of energy economy.

Radiation at uninsulated autoclaves:
equation for the calculation of heat loss:

$$Q_1\,[\text{Joule}] = q_1 \frac{[\text{Joule}]}{[\text{m}^2]\cdot[\text{h}]} \cdot F_1\,[\text{m}^2] \cdot T_H\,[\text{h}]$$

Q_1 = radiation losses [joules],
F_1 = radiating surface of the equipment [m^2]
T_H = temperature retention time [h],
q_1 = temperature dependent radiation coefficient for uninsulated equipment surfaces [joules/m^2h].

The following temperature dependent values apply for q_1, the radiation coefficient of uninsulated equipment surfaces [kJ/m^2 h]:

30°C	80
40°C	755
50°C	1215
60°C	1680
70°C	2265
80°C	2850
90°C	3480
100°C	4110
110°C	4775
120°C	5450
130°C	6285

These figures only apply with static environmental air. If the temperature varies over time, e.g. heating up, cooling down, then the temperature dependent radiation coefficient q_1 also changes. In this case, the heat loss is calculated based upon average temperature for heating up (from 40°C to 130°C, thus by 90°C), working with the corresponding q_1 value. Alternatively, the heating up curve may be divided into several vertical temperature increments and a corresponding number of horizontal retention times, whereby it is possible to detect the heat loss during the heating up phase in as many individual calculation operations as desired (iteration). The smaller the "step height" of the "temperature stairway", the more calculation operations have to be performed. The number of calculation operations determines the precision of the result.

① **Radiation intensity** of a light source corresponds to its power. It is significant for the illumination times in copying processes (contact printing process) for pattern transfer on rotary screen printing screens, however it does not influence the copying definition. Because the radiation intensity should be distributed as uniformly as possible during the illumination of a round screen cylinder, which is most true for parallelized light that falls at a radiation angle of 90°, screens are used to aid uniform distribution (e.g. honeycomb screens).

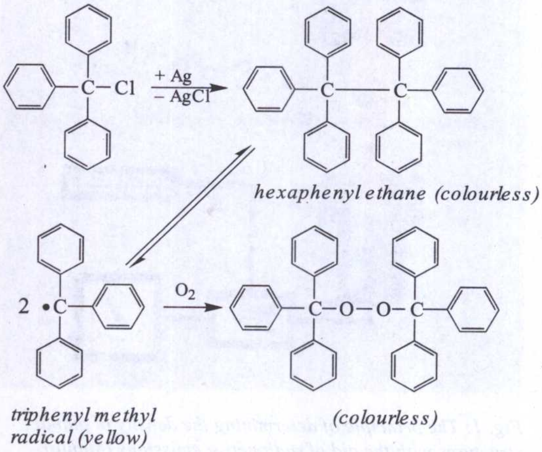
② **Radiation meters** Electrical devices for the direct detection of radiation, e.g. radioactive emission, ultraviolet radiation, X-rays, etc. Usually so-called counter tubes, in which the locally scanned radiation impulse (due to the ionization of the contents of the counter tube, a discharge impulse occurs, which triggers a voltage impulse at a working resistance) is measured via an amplifier by the deflection of the pointer of a normal current measurement instrument, or by means of a counter if there are low particle numbers. One common radiation sensor is the so-called Geiger-Müller counter, with which the intensity distribution along a length of material, length of thread, etc. can be measured.

③ **Radiation pyrometer** Instrument for non-contact measurement of temperature of bodies, e.g. of textiles during heat treatment.

④ **Radiation singeing** Indirect → Singeing, without contact between material and flames. The effect is achieved by re-radiation from bricks heated to high temperatures.

⑤ **Radicals** (Lat: radix = root) groups of atoms with free valency that cannot exist under normal conditions (unbound electrons). For example, if triphenyl methyl chloride is treated with finely-distributed silver in benzene in a vacuum, a yellowy solution is produced. If this solution is treated in air, the yellow colour disappears.

Radicals contain unpaired, free electrons that cannot be localised in the molecular structure because more than one valency structure (and therefore mesometric stabilisation) guarantees the existence of the radical. The free valency (the unpaired electron) is stabilised by the exchanging of many atoms (resonance) in the molecule.



① 辐射强度
② 辐射仪
③ 辐射高温计
④ 辐射烧毛
⑤ 自由基

Radioactive density determination

① 放射性密度测定

图 1：放射法测定平面结构密度

图 2：通过涂层前后的放射性密度测定控制涂层辊给液量

图 3：Gravimat 放射性密度测定仪开启时的放射模式图

The greater the number of possible mesomer forming limits, the greater the delocalisation of the free electron, thus reducing the total energy level of the radical and making it more stable (long-lasting). In the triphenyl methyl radical the unpaired, free electron can occur in ten different positions, namely in methyl carbon and in all other o and p positions in the three phenyl nucleii. The resulting resonant energy of the radical is about half as great as the binding energy of the C–C bond in hexyaphenyl ethane. The stability of the two triphenyl methyl radicals is so great that the equalisation reaction is displaced to the side of the dissociated substance. The colour of the triphenyl methyl radical results from the mesomer structures' capability of absorbing light energy.

In magnetic measurements radicals proved to be paramagnetic, because the spin of the lone electron is not compensated for. Organic compounds are normally diamagnetic.

① **Radioactive density determination** If emissions from radioactive isotopes penetrate material, its intensity is weakened in accordance with the mass of the irradiated layer (Fig. 1). The surface weight, thickness or density of the measured material can therefore be determined from the change in energy received from a radiation source of known intensity. The measurement is continuous and non destructive and has no effect on the properties of the tested material. The accuracy of surface weight measurement using isotope radiation and the measurement resolution are so good that changes of < 1 g can be determined in a material with a weight of 150 g/m^2, for example.

The radiation source is in a stable, radiation-proof housing whose efflux window is only opened when the device is switched on. If the power fails or is turned off, a steel disk covers the window automatically in order to protect the operators. Surface weight measuring systems also comply with the relevant radiation safety regulations. Special models can be provided (Fig. 2) for various measuring tasks such as monitoring and controlling the surface weight per square metre of effective material, measuring the thickness of coatings and other application techniques.

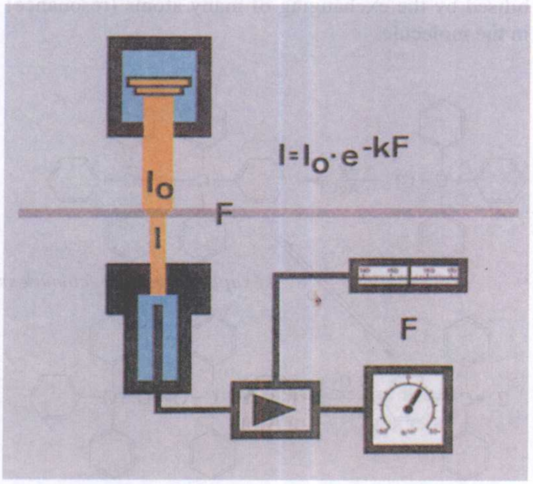


Fig. 1: The principle of determining the density of planar structures with the aid of radioactive emissions (Mahlo).

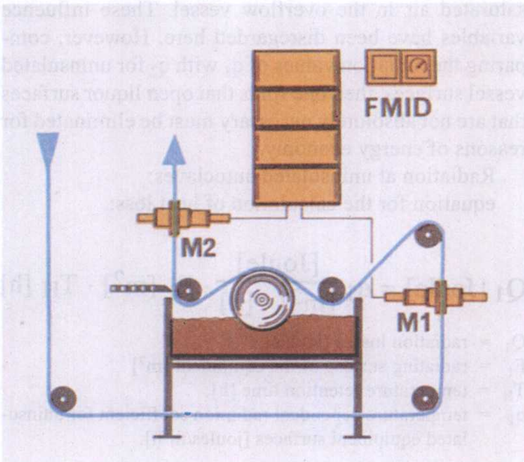


Fig. 2: Control (FMID) of product coating using a kiss roller by means of radioactive density determination (Mahlo) before (M1) and after (M2) coating.

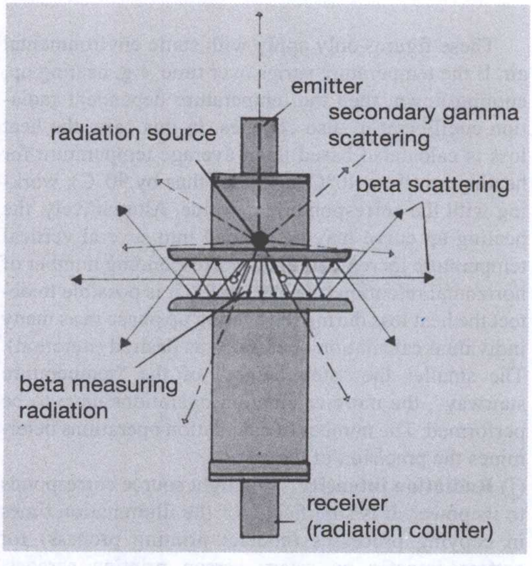


Fig. 3: The pattern of emissions from a Gravimat (Mahlo) for radioactive density determination when the radiation emission window is open.

During normal operation (device switched on, radiation efflux window open) most of the radiation originates from the transmitter, passes through the material into the receiver and is absorbed by both. Only a small proportion of the β-radiation crosses the measuring gap after several reflections. This rogue radiation only travels a short distance before it is absorbed by the air (Fig. 3). The effective quantity (dosage) of radiation around the measuring device with the radiation efflux window open and closed can be read off from so-called iso-dosage diagrams (Fig. 4). The curves in the diagram are calculated by combining values for the same dosage. The control range limit is also entered.

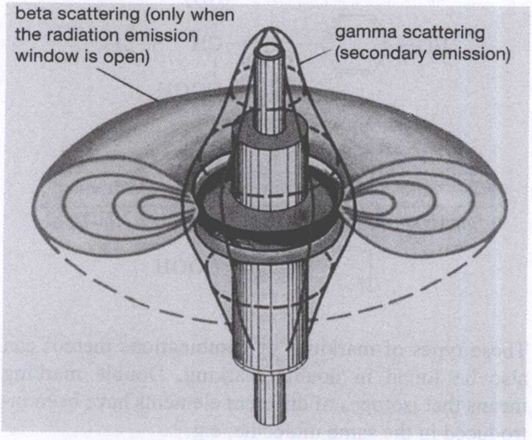


Fig. 4: The distribution of radiation emission surrounding the measuring device (Gravimat by Mahlo).

Since radiation is only emitted at the level of the material, hands and lower arms may be exposed to radiation during normal use at the stenter outlets (Fig. 5), on coating and laminating machines (e.g. when pulling in the material). The limits for partial exposure therefore apply when defining the monitoring area.

The currently applicable radiation safety legislation specifies radiation dosage limits for various groups of people, adherence to which ensures, with a high degree of probability, that radiation damage will not occur. In the eyes of the law, operators of machines and systems that are equipped with radiometric monitoring devices are not considered to be exposed to radiation at work, even if they occasionally come into contact with radiation. This group of people may only be subjected to a maximum dosage of 0.5 rem per annum if the entire body is exposed, and 6 rem per annum if only the hands, lower arms, feet and lower legs are affected. Starting from these limits, the radiation safety legislation defines a so-called monitoring area around a radioactive source. A dosage that is higher than the permitted body dosage may be received in this area; for this reason people are only allowed to be present in this area for a limited period. The maximum period is calculated from the radiation dosage at the location (local dosage) and the permitted limit. There are no access time restrictions outside the area.

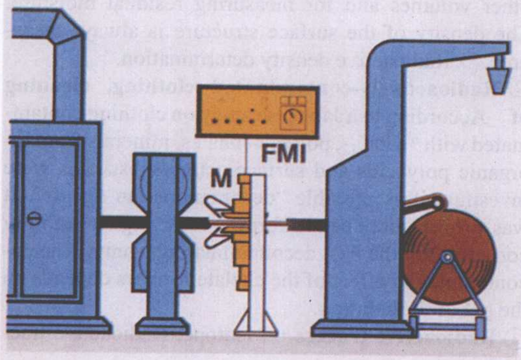


Fig. 5: Installation showing a Mahlo radioactivity based density determination device at the exit from a drier.

As with anything else to do with radioactivity, radioactive density determination is subject to strict monitoring by the relevant supervisory body, which only issues short-term usage authorisations that have to be renewed at certain intervals.

① **Radioactive emission** Energy emitted by so-called nuclear reactions from naturally radioactive elements (radium) or artificially produced radioactive → Isotopes of different elements. Consists of the following three types of radiation (neutrons, protons, etc. also occur in artificial radioactivity):

I. Alpha radiation (α radiation) emitted at considerable speed (initially approx. 17 000 km/s) by positively charged helium nuclei; considerable amount of ionisation, therefore only short range (approx. 3–8 cm), energy approx. 5 million eV.

II. Beta rays (β rays) are negatively charged electrons; they are extremely fast (initial speed 100 000 km/s. to almost the speed of light), penetrate much thicker layers than alpha beams (medium range), energy approx. 1 (– 3) million eV.

III. Gamma rays (γ rays) are extremely energy-rich light quantums (photons) with extremely short wavelengths (10^{-12} m), identical to x-rays from an x-ray tube operated at high voltage; they have little ionising effect (approx. 100 times less than beta rays, therefore long range and intensive penetration capability (including metal, water, etc.); much stronger than alpha and beta rays, gamma rays have an essentially destructive effect on fibres.

图 4:
测量装置周围的辐射分布

图 5:
烘干机出口处放射性密度测定器

① 放射线辐射

I. α 射线
II. β 射线
III. γ 射线

① 放射性同位素
② 清洗受放射性污染的服装
③ 放射性示踪物
④ 放射性示踪
⑤ 射频烘燥
⑥ 辐射控制系统
⑦ 灰尘辐射监测器
⑧ 酒椰韧皮纤维
⑨ 碎布地毯
⑩ 碎布

① **Radioactive isotopes** Isotopes that are used industrially for measuring textile coating thicknesses or other volumes and for measuring residual moisture. The density of the surface structure is always measured. → Radioactive density determination.

② **Radioactively-contaminated clothing, cleaning of** According to a Japanese study on clothing contaminated with $^{60}CoC_{12}$, polyphosphates, minerals from inorganic polyacids and surface-active substances were investigated as possible "decontamination agents". It was proven that chelate formers with higher stability constants are the best decontaminating agents. The decontaminating effect of the chelate formers depends on the pH of the solution.

③ **Radioactive tracers** →: Isotope; Radioactive tracing.

④ **Radioactive tracing** One of the goals of biochemical research is to explain the reaction mechanisms of the chemical process that occur in human, animal or organisms. Basically, everything that is absorbed by or built up in the organism is broken down after a time and excreted. Metabolism takes place between absorption and excretion. Among other things, the organism's dynamic state is characterised by the fact that no molecule stays in the same environment for a long period of time and many types of molecule are broken down into groups of atoms or even individual atoms and used by the organism to form other molecules. In order to trace the progress of the metabolic processes (e.g. sewage treatment) the use of radioactive molecules is usually unavoidable. Since the biochemical properties of the substance are not altered in any way by suitable marking, the molecules entering the organism can be differentiated from identical molecules that are already in the organism. Because of the radiation that they contain, marked substances can be identified at any time in any location without interfering with the progress of the metabolic process that is being investigated.

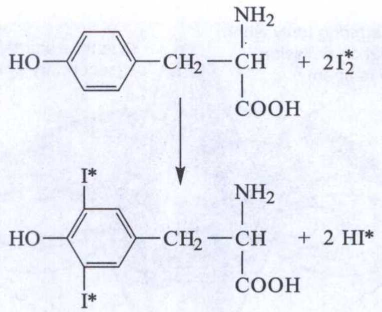
Using the tracer method it is possible to trace the route of a molecule type through the organism and determine any changes to which it may have been subjected. Kinetic investigations of the reactions in which the molecule is involved can also take place. As well as these possible applications, radioactive isotopes can also be used as indicators in various biochemical analysis methods in order to improve the accuracy thereof.

A distinction can be made between four basic marking methods using radionuclides:

1. Uniform marking (these kinds of marked compounds are identified with "U" in the literature). C-14 activity, for example, is statistically evenly distributed to all C atoms.
2. General marking (identified with "G"). This means that when using tritium marking, for example, all identical atoms are marked but the activity is not necessarily evenly statistically distributed.
3. Specific marking (marked by specifying the position, e.g. Alanine-1-C-14). In this case not all identical atoms in a compound are marked, e.g.

$$CH_3-\underset{\displaystyle NH_2}{\underset{|}{CH}}-\overset{*}{C}OOH$$

4. External marking. A radionuclide that is external to the molecule has been introduced, e.g.



These types of markings or combinations thereof can also be found in double marking. Double marking means that isotopes of different elements have been introduced in the same molecule, e.g.

$2-^{14}C-5-di-^{3}H$ mevalonic acid or
$H_2{}^{15}N-^{14}CH_2-COOH$.

⑤ **Radio-frequency drying** → High-frequency drying.

⑥ **Radiometric control systems** Testing procedure using isotopes such as → Radioactive density determination.

⑦ **Radiometric emission dust monitoring** Portable device for the continuous measurement and registration of mass concentration of dust in exhaust gases, e.g. from chimneys. The surface weight increase of a filter through which air or exhaust gas is flowing is determined by absorbing β rays. The following can be measured: dust quantity in kg, dust flow in kg/h, dust concentration in mg/Nm^3.

⑧ **Raffia bast** (raffia fibres), leaf bast (fibres) from the rapia palm (South Africa, Madagascar, South America). Flat, brown/yellow bast strands (for gardener bast and as braided bast for arts and crafts), easily divided lengthways to form solid fibre elements (for string and coarse yarns).

⑨ **RAG RUG** → Allgaeu carpet.

⑩ **Rags** Term for the remains of worn, more or less worn-out items of clothing from households. Usually end up in approx. 200 kg balls for further processing, which consist of grades (Class I = Shoddy, II = Tibet wool, III = Mungo, IV = Alpaca or Extract) and is used for manufacture of → Reclaimed wool, also → Reclaimed cotton.

① **Rain-Grown-Cotton** Cotton cultivated under natural climatic conditions (→ Irrigated cotton).

② **Rain resistance** → Water spotting fastness.

③ **Raised finish** (brushed finish, napped finish) → Brushed fabric.

④ **Raised resist print** Printing of pigment white and/or pigment dyes. Subsequent drying is followed by friction texturizing, condensing and raising. Produces a raised pile in non-printed areas, whereas printed areas are not raised.

⑤ **Raising** This finishing work is used to create a different feel and a velvety material surface on fabrics and knitwear by loosening a large number of individual fibres from the fabric and subsequent raising (velour raising) and napping (nap raising) in order to create a dense raised surface. This also produces more fullness and softer handle. A distinction is made between card roller raising (see Fig.) and table raising. Table raising machines are used to open knitwear, whereas card roller machines are used for raising threads (flat fabric or knitted fabric) or for raising felt (for milled woollen fabric) (→ Raising machines).

Depending on the kind of material, raising is carried out on right and/or reverse side of woollen materials,

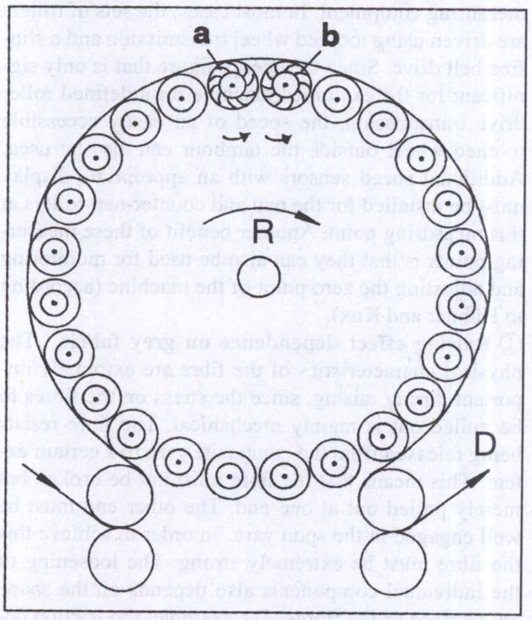


Fig.: The method of working of a raising machine fitted with carding rollers.
R = reel drum; D = direction of goods; a = counterpile roller; b = pile roller.

before milling in order to produce an extremely dense hair cover (for foulé), after milling for raising, the milling felt and also raising the face weft (for floconné) in cheap semi-woollen materials also without milling, before and/or after de-tanning (Melton character) in cotton materials, in order to give a woollen appearance and handle.

Raising is carried out on the raising machine, using either natural teasels or metal cards. Natural teasels are the heads of the teasel thistle (→ Raising machines). They have small hooks that are flexible and resistant and are suitable for achieving fine raising effects. The teasels are either placed in rods in rows (rod teasel raising machine) or put on small, rotating spindles (roller teasel raising machine) and arranged in an appropriate position on the raising cylinder, over which the material runs until the desired result has been achieved. Rod teasels produce a combed raising surface in the nap, and roller teasels produce more of an uncombed upright raising surface. In the first case the material is raised when damp and in the latter case is carried out when dry (for blankets, flannels, paletot materials). Coarse raising effects are achieved using metal cards. Cards are small wire hooks that are pulled over small rollers as a covering (→ Raising elements). Approximately 12–36 rapidly rotating card rollers are distributed around the large raising cylinder. The roller (card) raising machine has alternating nap and counter-nap rollers, i.e. with teeth that move with and against the direction of movement of the cylinder and the material. In universal card raising machines the cylinder moves in the direction of movement of the material and the card rollers run in the opposite direction, whereby counter-nap rollers also run between the latter. Raising machines have fine material tension, material web, raising roller speed, nap and counter-nap torque conversion (felting raising) control. The procedure can be simplified by arranging several successive machines, possibly with shearing machines at the end (raising shearing line). Raising machines allow the desired raising effect to be accurately set. Patterned high/low effects can be achieved by means of a combination of printing and raising. The low-lying areas are protected from the effect of the raising rollers by printing on a resisting agent and can also be dyed. A coloured or colourless artificial resin pre-condensate can be printed onto the raised material, calendered, condensed and then the nap brushed up again. The printed areas are now visible and embedded into the material.

⑥ **Raising apparatus** Small → Roller card raising machine before the rod teasel machine (wet brushing machine) central cylinder for pile lifting.

⑦ **Raising effect** Correct material tension is a decisive factor for a good raising result. If the tension is too high, the raising card cannot easily grip the weft thread, and if it is too loose the material may become tangled or

① 雨水灌溉棉
② 防雨
③ 起绒整理
④ 防起绒印花
⑤ 起绒，起毛

图：
钢丝起绒机的工作原理
R—起绒辊
D—织物运行方向
a—逆针辊
b—顺针辊

⑥ 起绒装置
⑦ 起绒效果

① 起绒效果与坯布的关系

even wrap around the raising rollers. The material must therefore always run at the best possible tension for the item that is being manufactured. On a PLC-controlled raising machine the material tension is automatically kept constant depending on the torque.

In a normal case, approximately equal amounts of nap and counter-nap energy are used on the nap/counter-nap raising machine. More nap energy is used to achieve certain material effects such as napped velour and less energy for a short, covered material surface. For nap velour, blankets and articles with voluminous raising, the raising machine is fitted with an additional lifting device above the cylinder. This equipment splits the cylinder into two zones; the raising capacity is increased and more volume is produced on the surface of the material. In this case too, the material tension is automatically kept constant depending on the torque.

If the raised surface of the material that has been raised using nap/counter-nap is to be made even denser, a semi-felting process is frequently carried out using a nap/counter-nap raising machine. In this case the nap energy is under zero and low-grip counter-napping is carried out. If the surface of a material has to be extremely compact, the full felting raising procedure is used. In this case the cylinder rotates against the direction of movement of the material, and all the raising rollers operate in the nap direction. It is important that the elements are symmetrical, i.e. both banks of rollers are at the same angle.

Different raising elements are used for certain materials. As well as the shape of the wire (round, oval, sectoral or biconvex wire) the embedding and straightness of the wires, the number of naps, the row and the density of the braiding must be taken into consideration for further characterisation. The wire shape and straightness are important criteria for raising card wires, and the grinding of the tip of the card wire is also extremely important. During the processing of woven materials, equalised, side-ground and polished raising elements that have been ground outside the tambour raising machine must be used. In knitwear where raising and velouring take place using a raising card wire tip, the raising card wire tips (controlled by a preselected PLC program) are ground in the raising machine.

An important parameter during raising is also raising energy. This generally refers to the set nap and counter-nap roller speeds. Because of the complicated kinematics of a wire raising machine, these speeds cannot be directly measured. Most machines have dimensionless scales for setting the raising energy, which make it possible to reproduce the settings that have already been used.

Raising energy is the rotation energy E_{rot} of a raising roller:

$$E_{rot} = 1/2 \cdot I \cdot w^2$$

I = moment of inertia of the roller,
w = angular velocity of roller.

If w is expressed as the rotating speed, the following applies to E_{rot}

$$E_{rot} = 2\,\pi^2 \cdot I \cdot n^2$$

For a certain roller, E_{rot} is proportional to the square of its rotating speed.

$$E_{rot} = \text{const.} \cdot n^2$$

No raising energy is transferred at the "zero point" of the respective machine, since the hooks embedded in the covering roll off the material without carrying out any raising work. The energy figure EZ is used as a measure of the raising work carried out on the material by the covering:

$$EZ = \frac{n^2 - n_0^2}{1000}$$

n = roller speed at any setting (rpm),
n_0 = zero point speed (rpm).

The energy figures are > 0 for counter-nap rollers and < 0 for nap rollers. The speeds of the individual sets of raising rollers can only be measured using expensive measuring equipment. In most cases, the sets of rollers are driven using toothed wheel transmission and a slip-free belt drive. Since the energy figure that is only significant for the examined machine for a defined roller drive transmission, the speed of an easily accessible toothed wheel outside the tambour can also be used. Additional speed sensors with an appropriate display must be installed for the nap and counter-nap rollers at this measuring point. Another benefit of these measuring points is that they can also be used for monitoring and adjusting the zero point of the machine (according to Hübner and Kux).

① **Raising effect dependence on grey fabric** The physical characteristics of the fibre are extremely important during raising, since the stress on the fibres to be pulled out is mainly mechanical. The fibre resists being released from the composite yarn to a certain extent. This means that the fibre must not be broken but merely pulled out at one end. The other end must be well engaged in the spun yarn. In order to achieve this the fibre must be extremely strong. The loosening of the individual components also depends on the shape and surface of the fibres. For example, the friction coefficient of wool (flaky surface structure) is greater than that of smooth synthetic fibre. Regardless of the material that is used, loss of strength in the weft direction can be expected when raising fabrics since it is essentially the weft fibre that is raised. The rigid bonding is disturbed by raising. The weft yarn that produces the raising pile must be carefully selected. The choice of weft yarn depends on staple length, fineness, twist and yarn number.

1. Staple length: in order to make weft yarn raising easier, a material that has as short a staple as possible must be used. The many fibre ends can be pulled to the surface of the fabric after relatively few raising passages, where they form a dense raised fleece. However, using short-stapled material rapidly reduces the tearing strength of the fabric in the weft direction because the fibres have not internal cohesion. An unstable pile is also created. More passages are required if long-staple material is used, but this produces better tearing strength and a balanced, stable raising surface. Raising loss is also minimised.

2. Fibre fineness: the fineness of the fibres must be tailored to the respective grey material. Coarser, long-staple fibres are the most suitable for carpet and blanket manufacture. Finer material is better for clothing, since it has to form a short, dense pile surface. The fineness and length of the fibres play an important part with regard to the density and length of the pile.

3. Yarn twisting: the harder a yarn is twisted, the further the raising wire has to engage into the bond. This characteristic can be used to positive effect if a light, short surface pile is all that is required. Attempting to obtain a voluminous surface may cause loss of fabric tearing strength and raising. The number of raising passages also increases, which is undesirable from an economic point of view. With regard to the effect of the yarn number on raising fallout, it can be said that the coarser the weft yarn, the better the grip of the small raising hooks, thus making the raising process easier. For warp yarn a finer yarn number must be selected, since the warp thread should be covered as little as possible.

4. Fabric binding: the raising effect mainly depends on the binding of the material. A correctly selected binding plays an important part in retaining fabric tearing resistance in the warp direction. Bindings with long weft floats make raising easier, but there is a risk of irregular pile formation. Cloth binding, which is frequently used in raising, is extremely suitable because its floats are not too long and the fact that the number of intersection points is adequate. Since every thread crossing counteracts the loosening of the fibres, cloth binding does not produce a tight pile. Cloth binding is therefore used in cases where short, wash-fast raising fleeces are required. Tight surfaces are achieved using weft satin. More raising density is achieved, which is given a velvet-like character by shearing. A large number of other binding types are used in raising (Köper, Atlas, etc.). The choice always depends on the article's requirement profile.

In raising a distinction is made according to the type of material to be processed (cotton, wool, synthetics) and according to the type of raising.

– raising of threads,
– raising of felt.

When raising threads a pile cover is formed by pulling out fibres from the threads or by lifting or tearing the thread, which is bound into the surface as floating or raised loops. The raising of felt, on the other hand, is only used in wool raising, i.e. the wool is given a short, dense fibre pile cover in the milling process. Wool felts during milling, because of its flaky surface structure. In this case raising does not have the task of pulling fibres out of the bonding but loosening the felted surface pile. A distinction is also made between different raising procedures:

– raising with/against the nap,
– nap raising,
– felting.

① **Raising effect tester** Used to measure the raising effect (pile height) so that this effect can be reproduced under the same conditions.

② **Raising elements** A distinction is made between nap and counter-nap rollers as far as raising rollers is concerned. An alternating series of these rollers lies against the raising drum. Basically, the two types of roller differ in that the card teeth are bent in different directions in relation to the direction of rotation. On the basis of the direction of movement of the material, the direction of rotation of the cylinder and the nap and counter-nap rollers, it can be seen that the bent card runs against the material in the counter-nap, whereby the nap roller merely strokes the material.

The raising cards have to grip into the fabric, and the nap and counter-nap rollers have to be separated in order to do this. The raising effect can be increased by:

– reducing the speed of the nap rollers,
– increasing the speed of the counter-nap rollers,
– reducing the tension of the material so that the material to be raised has contact with the raising rollers over a larger area (Fig. 1).

The following principles apply:

a) The lower the speed of the nap rollers, keeping the rotating speed of the raising drum constant, the longer and more powerful the effect of the counter-nap effect on the fabric.
b) The greater the speed of the counter-nap rollers, the greater the raising effect.

The raising machine can also be set up such that the nap and counter-nap rollers just roll against the material. This is called the zero effect, i.e. there is no raising effect in this setting (Figs. 2 and 3). The effect of a raising machine can therefore be varied from no raising effect in the zero setting up to an intensive nap and counter-nap roller effect until actual damage is caused to the material, whereby the fabric tearing strength in the weft

起绒纬纱的选择取决于：
1. 纤维长度
2. 纤维线密度
3. 纱线捻度
4. 织物结合程度

① 起绒效果测试仪
② 起绒元件

Raising elements

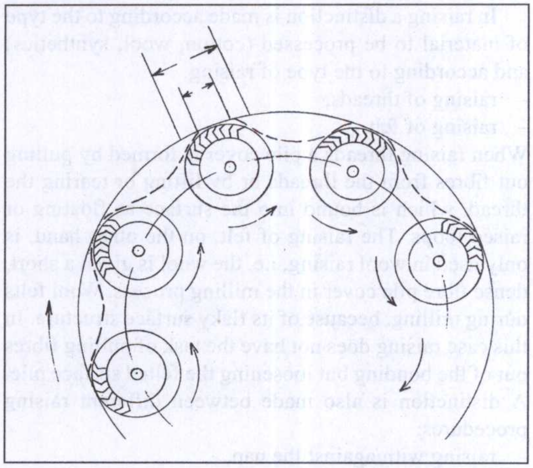


Fig. 1: Nap and counter-nap rollers and the influence of the tension of the fabric.

图 1:
顺针辊和逆针辊对织物张力的影响

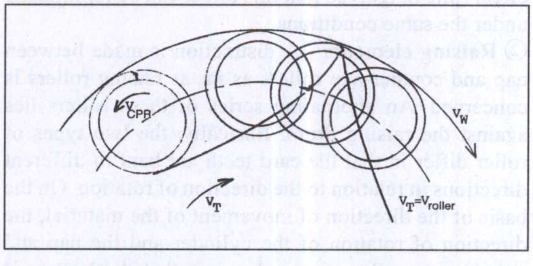


Fig. 2: Curve showing the motion of a raising roller (here a counter-nap roller) where $v_T = v_{roller}$ (zero effect).

图 2:
逆针辊的运动曲线

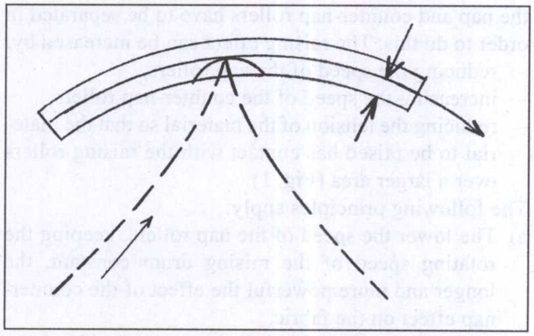


Fig. 3: Curve showing the motion of a carding hook against the fabric at the zero effect point.

图 3:
钢丝与织物在零作用点的相对运动曲线

direction falls below an acceptable level. Because the raising rollers and the cylinder move in opposite direction, hypo-cycloidic movement curves occur, i.e. a curve that forms at a peripheral point on a circle if this circle rolls off the inner side of another fixed circle. The shape of the curve is determined by the cylinder speed to roller speed ratio. The material speed and tension (depth of raising hook engagement in fabric) also play a part in determining the movement curve of a raising hook in the fabric. When the material speed changes, the movement of the card hooks in the fabric is no longer identical with the hypo-cycloids of the free-running raising roller. In order to guarantee that the nap rollers have a raising effect, the circumferential speed must be reduced (Fig. 4). In the operating position, the card hook approaches the material web in a slightly bent line (Fig. 5). When the card touches the material web it has time to scrape along the surface of the fabric over a short distance. It is then removed from the material web. On the counter-nap roller the roller speed is increased in order to achieve the raising effect (Fig. 6).

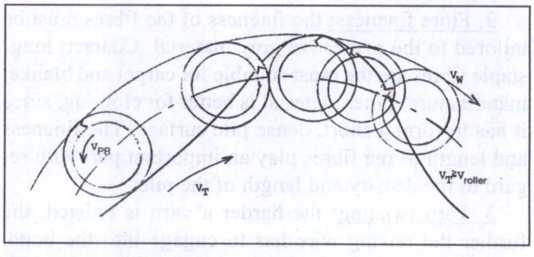


Fig. 4: Curve showing the motion of a carding bristle on the nap roller at the working position ($v_T \geq v_{roller}$).

图 4:
顺针辊钢丝在工作位置上的运动曲线

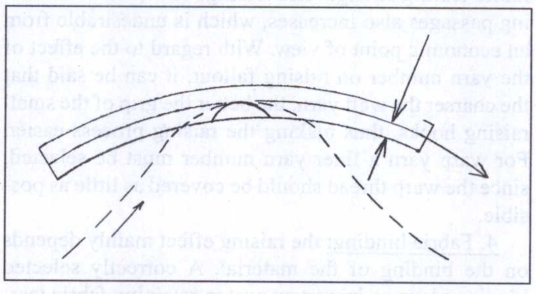


Fig. 5: Curve showing the motion of a pile roller hook against the fabric.

图 5:
顺针辊钢丝与织物的相对运动曲线

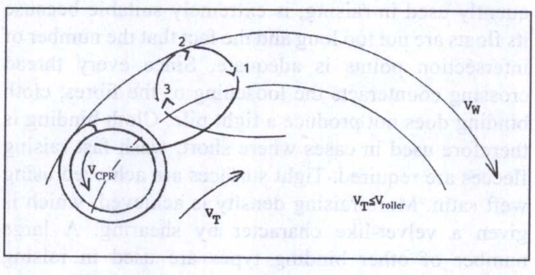


Fig. 6: Curve showing the motion of a carding bristle on the counter-nap roller at the working position ($v_T \leq v_{roller}$).

图 6:
逆针辊钢丝在工作位置上的运动曲线

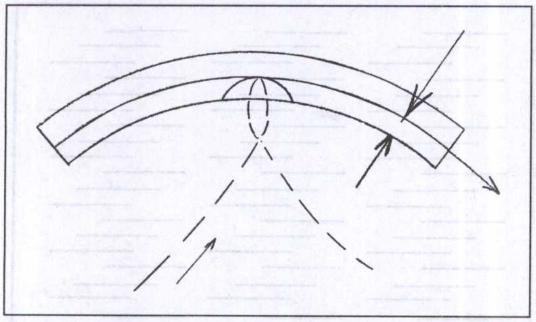


Fig. 7: Curve showing the motion of a counter-nap hook against the fabric.

The tip of the card, which is aligned against the material direction of travel and at an angle to the cylinder movement, runs along a loop-like route when it approaches the fabric (Fig. 7). After a brief, rounded engagement into the surface of the fabric, the card tip is removed from the material extremely rapidly. The greater the speed, the larger the loop. This causes the raising card to engage in the fabric for a longer period. In summarising it can be said that the material (v_W), cylinder (V_T) and raising roller speeds (v_{roller}) influence the raising effect. If one considers the movement of the raising cards, the regularity of the actual raising speed and the operating speed of the raising rollers V_{OCPR} and V_{OPR} can be calculated. The formula for calculating the operating speed of the nap and counter-nap rollers is:

$$V_{OPR} = V_T - V_{PR} - V_W$$
$$V_{OCPR} = V_{CPR} - V_T + V_W$$

V_{OPR}; V_{OCPR} = operating speed of nap and counter-nap rollers
V_{PR}; V_{CPR} = circumferential speed of nap and counter-nap rollers
V_T = cylinder speed
V_W = material speed

A distinction between raising cards is made according to the type of wire and the carrier material. As far as wire is concerned, a distinction is made between round wire, biconvex wire, sector wire, ovoid wire and flat wire in different sizes. Card wires are made from high quality cast steel with carefully controlled alloys. Carbon (0.57–0.62%), manganese (0.5–0.6%), silicon, phosphor and sulphur are used as alloying materials. These additions produce a wire that meets all elastic, hardness, durability and processing (polishing) requirements. Depending on the use, rubber or felt covered plates are used as the carrier. The selection depends on the type of raising material and the required raising effect, i.e. the card elements must meet the following requirements for the article concerned:

- adequate strength,
- the required elasticity,
- the required card tooth angle effect.

The carrier materials consist of various layers of textile fabric that are bonded together. As far as rubber plates are concerned, the layers of material are covered with a mineralised and vulcanised rubber plate. The thickness of the rubber plate depends on the use (usage area). As far as felt covering plates are concerned, the layers of material are bonded with felt. The choice of carrier material depends to a great extent on the required elasticity of the raising card.

The needles that are used are subject to the following requirements:

- adequate strength,
- required elasticity,
- high degree of wear resistance,
- same angle and tip height.

Selecting the correct type of steel can meet the first three requirements. The first two items are also influenced by wire thickness and cross section. Wear resistance can be improved by hardening the element tips. Galvanised elements are available for wet and damp raising. Particular attention must be paid to the last item, since it is responsible for raising failure and performance. A distinction is therefore made between two types of trimming elements:

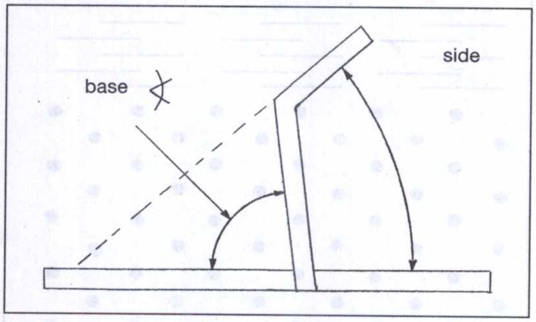


Fig. 8: Normal trimming elements.

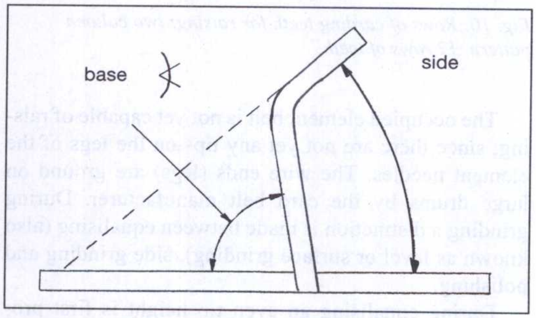


Fig. 9: Round knee trimming elements.

图 7：
逆针辊钢丝与织物的相对运动曲线

图 8：
常规针膝

图 9：
圆针膝

图 10：起绒机钢丝排列：两行式，12 列齿

图 11：起绒机钢丝排列：三行式，18 列齿

a) normal elements (Fig. 8),
b) round knee elements (Fig. 9).

The basic angle setting is intended to give the trimming elements more elasticity. If the basic angle is reduced (wire bent backwards) the raising card has more elasticity. Normal versions have basic angle settings of 75–85°. If a less elastic version is required, a curved needle (round knee elements) is chosen rather than a needle with a sharp bend (normal elements).

The raising elements get their appearance (angle, wire length, rows of carding teeth) during the manufacture of the raising card belts in setting machines. The wire is cut to the required length and bent into a "U" shape; this creates two element needles. Holes are punched into the carrier material into which the bent wire is subsequently inserted. When the wire is inserted the card is given its final shape, angle position (basic and leg angle) and arrangement of rows of carding teeth (Figs. 10, 11). The row of teeth describes the arrangement of the element needles in the carrier material.

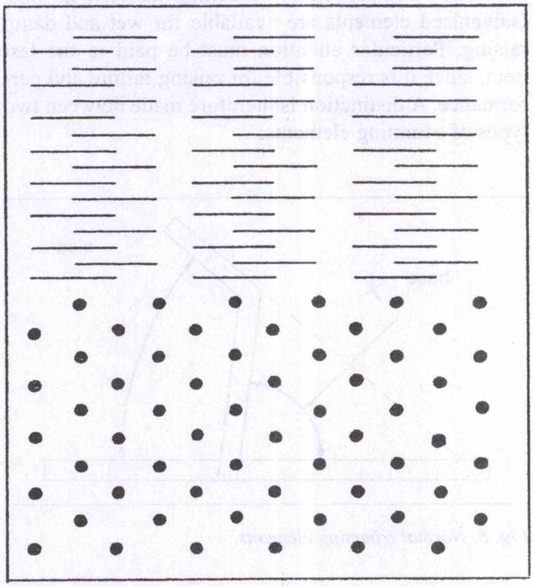


Fig. 10: Rows of carding teeth for raising: two column pattern, 12 rows of teeth.

The occupied element belt is not yet capable of raising, since there are not yet any tips on the legs of the element needles. The wire ends (legs) are ground on large drums by the card belt manufacturer. During grinding a distinction is made between equalising (also known as level or surface grinding), side grinding and polishing.

During equalising an even tip height is first produced. This is not always guaranteed when the element

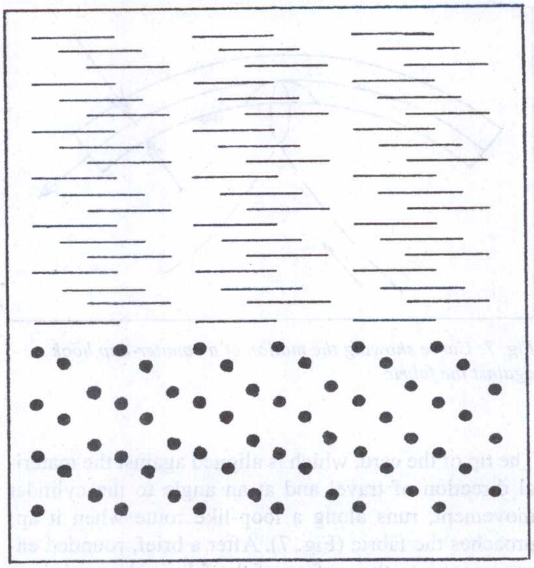


Fig. 11: Rows of carding teeth for raising: three column pattern, 18 rows of teeth.

belt is manufactured, since erroneous wire lengths may be produced. The back is given its shape by the grinding disc pressure and the grinding time. A distinction is made between: grinding, thin grinding and flat grinding (Figs. 12–14).

The tips and card edges are formed during side grinding. For some time, raising experts were not certain whether side grinding was required. In the meantime it has been established that side grinding makes raising more economical and does not affect quality. This is why card manufacturers always supply side-ground raising elements. Here too a distinction is made between grinding, thin grinding and flat grinding. The advantage of side grinding is that the element needle can penetrate the fabric more easily. The needle stays sharp for longer. The disadvantage is that a burr is created on the underside of the leg. The fibres to be loosened can catch on the sharp edge and plucks and holes can appear in the fabric. In practice, new elements are initially used for pre-raising only. In order to prevent this problem the card elements are polished. The card elements wear during long periods of use, i.e. they become blunt, the card tips slowly back in the direction of the wire shape. The wearing process is accelerated by harder materials and weft yarns with a stronger twist. The continual wear of the card tips reduces the performance of the raising machine. This results in multiple passes being required. On the other hand, open bindings and softer weft yarns increase the service life of the raising card and reduce the need for grinding.

Worn raising elements are ground in, thus produc-

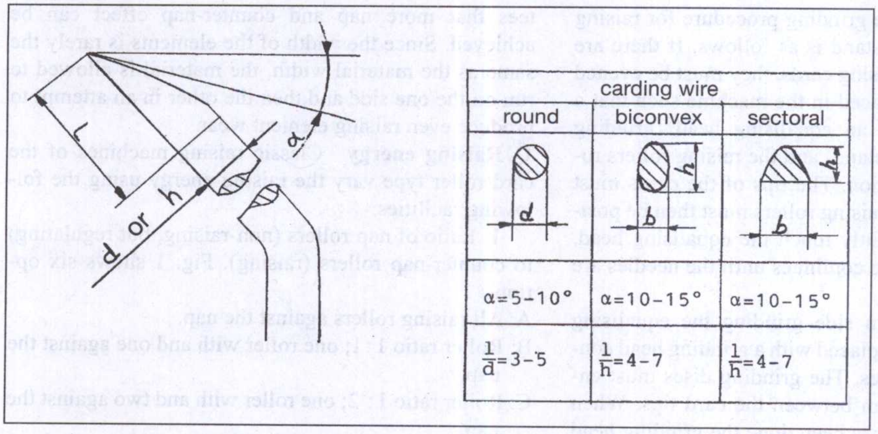


Fig. 12: Grinding forms for levelling: grinding.

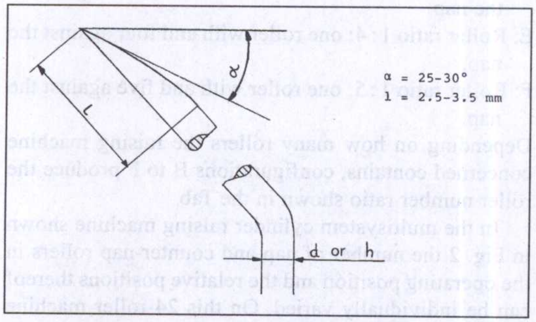


Fig. 13: Grinding forms for levelling: thin grinding.

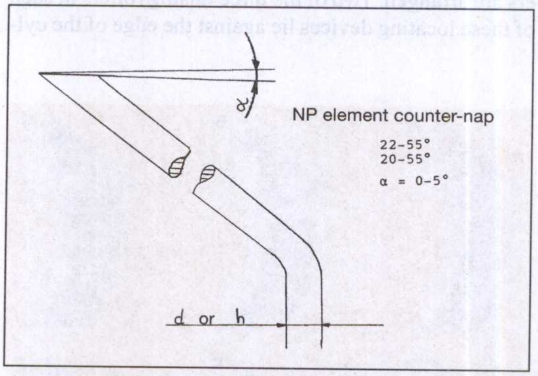


Fig. 14: Grinding forms for levelling: flat grinding.

ing a good raising effect. There are two ways of grinding raising rollers:

1. Grinding the removed raising card roller on a grinding stand (Fig. 15).
2. Grinding the card elements in the raising machine (Fig. 16).

Both grinding methods work according to the principle of equalising, side grinding and polishing. The raising card elements that have already been used must first be cleaned. Flocks, threads, dust, etc. obstruct the grinding process. This leads to different grinding results that are subsequently noticeable on the article to be raised

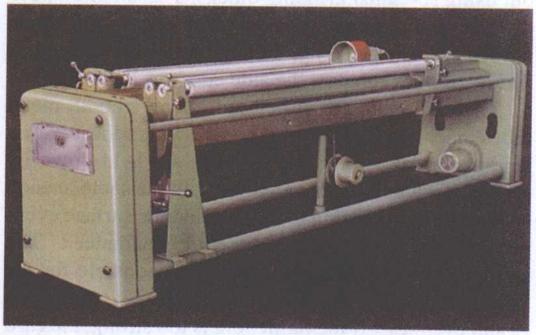


Fig. 15: A card grinding machine AH 5 (grinding stand) by Franz Müller.

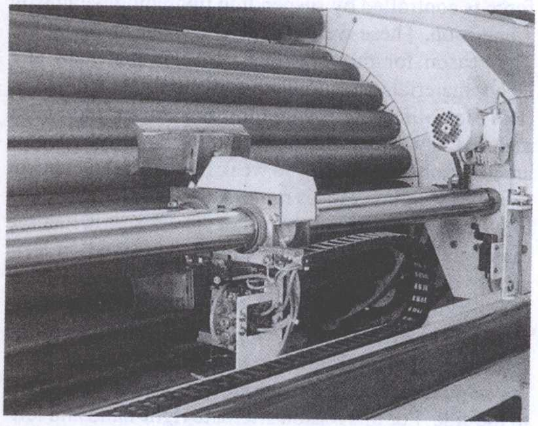


Fig. 16: An automatic raising element sharpening device from the Sucker-Müller company.

图 12:
磨针形式

图 13:
磨针形式：轻磨

图 14:
磨针形式：平磨

图 15:
磨针布机

图 16:
祖克—米勒自动
磨针辊装置

① 起绒能量

图 1:
起绒机上逆针辊（红）和顺针辊（蓝）之比决定起绒能量的大小

(e.g. unequal nap). The grinding procedure for raising cards on the grinding stand is as follows. If there are uneven areas on the raising cards, they must be evened out. Two rollers are placed in the machine such that a grinding spindle with an equalising head (grinding stone unit in grinding stand) and the raising rollers rotate in the same direction. The tips of the cards must point backwards. The raising rollers must then be positioned so that they lightly touch the equalising head. The grinding procedure continues until the needles are of equal height again.

In order to perform side grinding the equalising head is removed and replaced with a grinding head consisting of grinding discs. The grinding discs must engage approx. 1–1.5 mm between the card tips. When enough side grinding has been done the grinding head is removed. Then de-burring (polishing) is done. In this case the raising rollers are allowed to run into each other, whereby a certain quantity of oil and fine grinding paste must be added, since polishing would otherwise not be possible. When in-machine grinding is carried out, equalising, side grinding and polishing is carried out using so-called grinding blocks. These blocks have different grain sizes. A special grooved grinding stone is used for side grinding, unlike other grinding stones. These grooves rub past the side edges of the card.

The card belts are pulled onto bare, smooth metal tubes, each winding in turn coated with adhesive in a spiral. For safety reasons the ends are held down by screws. Tightening must be done with the same tension so that the belt winding is flexible and the surface evenness of the raising card therefore guaranteed. The strength of the tightening is partly responsible for the flexibility of the cards. Flexibility is decisive for quality and evenness. If the tightening is too strong, the card loses the required flexibility, i.e. it does not give way when it engages into the material, resulting in multiple passages and inadequate nap formation. The tightening force is controlled by suspending tightening weights in a belt loop. These weights vary between 5 and 20 kg. The reason for the large difference is that hard and heavy materials have to be raised and tightened harder (less flexibility, more weights). For looser and softer material more flexibility is required, and fewer weights are used for tightening. Too weak tightening an element (without weights) causes running, i.e. the element starts to wander and runs off the roller. The result is that the material tears and the element is destroyed; it gets caught up in the other raising rollers and the element needles break off. The screw-shaped tightening of the elements positions the wire leg at a certain angle to the direction of travel. If all the raising rollers were bent in the same direction, the material web would wander off to the side. For this reason alternate right-hand and left-hand rollers are installed. If possible, the change should take place within the two groups, which thus guarantees that more nap and counter-nap effect can be achieved. Since the width of the elements is rarely the same as the material width, the material is allowed to run on the one side and then the other in an attempt to produce even raising element wear.

① Raising energy Classic raising machines of the card roller type vary the raising energy using the following facilities:

1. Ratio of nap rollers (non-raising, but regulating) to counter-nap rollers (raising). Fig. 1 shows six options:

A: All raising rollers against the nap.

B: Roller ratio 1 : 1; one roller with and one against the nap.

C: Roller ratio 1 : 2; one roller with and two against the nap.

D: Roller ratio 1 : 3; one roller with and three against the nap.

E: Roller ratio 1 : 4; one roller with and four against the nap.

F: Roller ratio 1 : 5; one roller with and five against the nap.

Depending on how many rollers the raising machine concerned contains, configurations B to F produce the roller number ratio shown in the Tab.

In the multisystem cylinder raising machine shown in Fig. 2 the number of nap and counter-nap rollers in the operating position and the relative positions thereof can be individually varied. On this 24-roller machine there are twelve triangular locating devices in each side section of the roller, in which a total of 36 raising rollers are arranged. Two of the three raising rollers in each of these locating devices lie against the edge of the cyl-

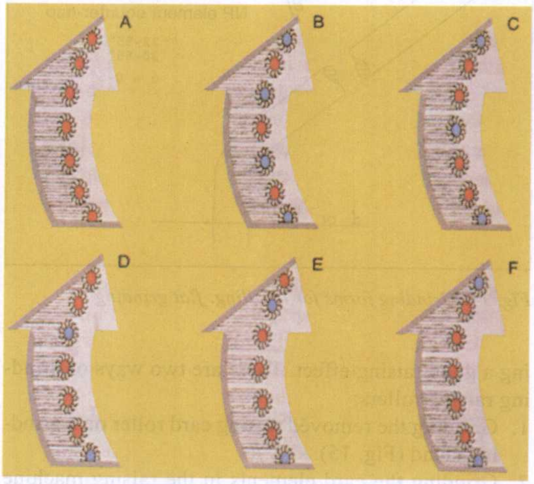


Fig. 1: The ratio of counter-nap rollers (red) and nap rollers (blue) on the reel drum determine the level of raising energy applied.