with satisfactory aesthetic quality is problematic. In order to ensure that these surfaces for example in the case of inner liners have the same reflectiveness everywhere the same minimal specific embossing pressure has to be expended everywhere. However, this is not possible without suitable measures when there are minute local deviations of the geometry between male die and female die rollers, which let the local embossing pressure vary greatly. In the case of tolerances that are too close and high pressures, embossing creates holes. High pressures can negatively affect the sandwich texture of an inner liner which at elevated temperatures results in the degradation of the same due to a varnish stain being formed on the back of the paper.

The maximum pressure that can be practically applied without greater expenditure today is around for example 3,000 N/per an area of 150 mm times 1 mm; roller length times embossed width on a roller of approximately 70 mm diameter. The paper thickness which by nature varies locally in the case of cellulose cannot be compensated either.

If many freely shaped patterns are present on the same roller surface, the paper can easily crumple because of locally different paper stretch. The high sampling density that is required today increases this problem even further.

Starting out from this prior art, ~~it is the object~~ embodiments of the present invention ~~to state~~ seek to provide an embossing device with an embossing roller set having at least two male die and female die rollers which cooperate with one another, which does not only allow carrying out fine embossing for a wide range of described surface textures of the wide range of material types in online

operation of a packaging plant but additionally the high-quality eye-catching fine embossing of sophisticated logos such as for example mythical creatures, letters and the like. ~~This object includes~~ Embodiments of the present invention further seek to provide the creating of stepped grades of brilliance and of stepped contouring. ~~Such a device is defined in the independent patent claim 1.~~

According to an aspect of the present invention, there is provided an embossing device for embossing packaging material with a set of embossing rollers having male die and female die rollers co-operating with one another, the surfaces of which are provided with texture elements, wherein the texture elements on the surface of the female die roller(s), which are assigned to the texture elements on the surface of the male die roller(s), are not inversely congruent by an amount of above 15 μm in axial and radial direction and the texture elements of the male die and female die roller(s) assigned to one another have facets for the purpose of local pressure increase.

In general, fine embossing is to mean that the contours of the fine embossing textures of the rollers have a linear total error in axial and radial direction of less than +/- 10 μm and/or an angle error of less than 5°.

~~Further objects and advantages are obtained from the dependent claims and the following description.~~ In the following, the invention is explained in more detail with the help of drawings of exemplary embodiments.

Fig. 1 shows schematically a device with a set of embossing rollers with a male die and

a female die, each of which are provided with a simple texture,

Fig. 1A shows schematically a facetted rounding,

Figs. 2, 2A show schematically a sign with facets,

Figs. 2B - 2E illustrate schematically four rules for facets,

Figs. 3 - 5 show schematically sectional drawings of designs of male die and female die textures which are not inversely congruent,

PATENT CLAIMS

1. An embossing device for embossing packaging material with a set of embossing rollers having male die and female die rollers co-operating with one another, the surfaces of which are provided with texture elements, wherein the texture elements ~~(MR)~~ on the surface of the female die roller(s) ~~(M)~~, which are assigned to the texture elements ~~(PE)~~ on the surface of the male die roller(s) ~~(P)~~, are not inversely congruent by an amount of above 15 µm in axial and radial direction and the texture elements of the male die and female die roller(s) assigned to one another have facets ~~(F)~~ for the purpose of local pressure increase.

2. The embossing device according to claim 1, ~~characterized in that~~ wherein a facet ~~(F)~~ has faces ~~(FN, FR, F1 – F4)~~, which with respect to the imaginary, continuous surface of the texture are inclined.

3. The embossing device according to claim 1 or 2, ~~characterized in that~~ wherein the minimal area of a facet is 0.4 mm x 0.4 mm, or 0.16mm^2.

4. The embossing device according to any one of the claims 1 to 3, ~~characterized in that~~ wherein it comprises a male die roller ~~(P9)~~ and two female die rollers ~~(M9A, M9B)~~, wherein the device includes means so that the male die roller ~~(P9)~~ with the male die elevation ~~(P9E1, E2)~~ first interacts with the first female die roller ~~(M9A)~~ with the associated female die depression ~~(M9AR1, 2)~~ than with the second female die roller ~~(M9B)~~ with the associated female die depression ~~(M9BR1, 2)~~.

5. The embossing device according to any one of the claims 1 to 3, ~~characterized in that~~ wherein it comprises a female die roller ~~(M10-13)~~ and two male die rollers ~~(P10A-13, P10B-13)~~, wherein the device includes means so that the female die roller ~~(M10-13)~~ with the depression ~~(M10-13R10-13)~~ first interacts with the first male die roller ~~(P10A-13)~~ with the associated male die elevation ~~(P10A-13, R10-13)~~, than with the second male die roller ~~(P10B-13)~~ with the associated male die elevation ~~(P10B13R10-13)~~.

6. The embossing device according to claim 4, ~~characterized in that~~ wherein the male die roller ~~(P9)~~ and the female die rollers ~~(M9A, M9B)~~ are arranged in a three-roller embossing device, wherein the elevation ~~(P9E1, 2)~~ are arranged on the male die roller in such a manner that during the embossing process they interact one after the other with the recesses ~~(M9AR1, 2)~~ of the first ~~(M9A)~~ and with the recesses ~~(M9BR1, 2)~~ of the second female die roller ~~(M9B)~~.

7. The embossing device according to claim 4, ~~characterized in that~~ wherein the male die roller ~~(P9)~~ and the female die rollers ~~(M9A, M9B)~~ are each arranged in pairs in a two-roller embossing device.

8. The embossing device according to claim 5, ~~characterized in that~~ wherein the female die roller ~~(M10-13)~~ and the male die rollers ~~(P10A-13, P10B-13)~~ are arranged in a three-roller embossing device, wherein the recesses ~~(M10-13R10-13)~~ are arranged on the female die roller in such a manner that during the embossing process they interact one after the other with the elevations ~~(P10A-13E10-~~

~~13)~~ of the first ~~(P10A-13)~~ and with the elevations ~~(P10B-13R10-13)~~ of the second male die roller ~~(P10B-13)~~.

9. The embossing device according to claim 5, ~~characterized in that~~ wherein the female die roller ~~(M10-13~~ and the male die rollers ~~(P10A-13, P10B-13)~~ are each arranged in pairs in a two-roller embossing device.

10. The embossing device according to any one of the claims 1 to 9, ~~characterized in that~~ wherein the height, or depth of the elevations and recesses and the number of embossing rollers are arranged and designed in such a manner that through multiple embossing high or raised reliefs are created, the height or depth and width of which are greater than the remaining textures.

11. The embossing device according to any one of the claims 1 to 10, ~~characterized in that~~ wherein the diameter of one of the embossing rollers is produced at least over the width of the web of the packaging material with a diameter that is smaller by an amount S than the rest of the embossing roller, wherein S has a value of over 0.02 mm.

12. The embossing device according to any one of the claims 1 to 11, ~~characterized in that~~ wherein at least the surface of the embossing rollers consists of metal, hard metal, hard material or ceramic, wherein the surface if appropriate is provided with a protection layer.

13. The embossing device according to any one of the claims 1 to 12, ~~characterized in that~~ wherein the embossing roller set is arranged in a quick-change

device ~~(30, 59)~~, which is embodied in such a manner that the embossing rollers ~~(36, 37)~~ can be replaced individually and independently of one another, wherein the embossing rollers ~~(36, 37)~~ are each rotatably held in a roller carrier ~~(34, 35)~~ and the roller carriers are fastened individually and removably independently of one another in a quick-change housing in an unambiguous position, wherein an end of the male die roller carrier ~~(34)~~ is held in a needle bearing ~~(42)~~ and its other end in a ball bearing ~~(43)~~.

14. The embossing device according to claim 13, ~~characterized in that~~ wherein the one roller carrier ~~(34)~~ on its lower part comprises a key ~~(49)~~ and the bottom of the housing ~~(31, 60)~~ a corresponding slot ~~(48)~~.