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**H. GREEN**

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# APPARATUS FOR MEASURING ADHERENCE OF COATING FILMS

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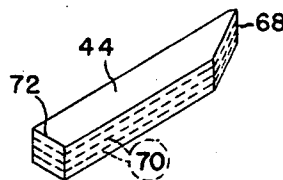
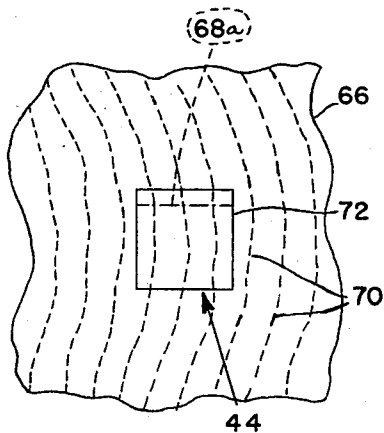
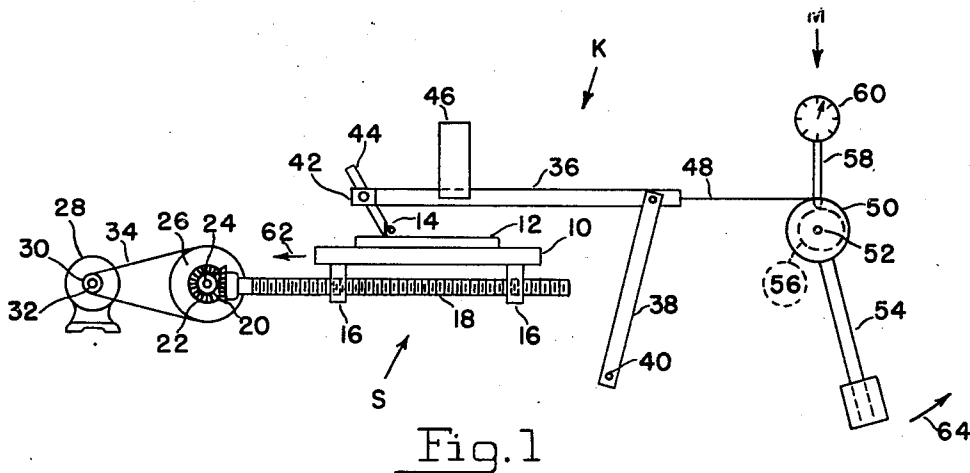


Fig.3

Fig. 2

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## UNITED STATES PATENT OFFICE

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APPARATUS FOR MEASURING ADHERENCE  
OF COATING FILMS

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This invention relates to the determination or measurement of the adherence of a coating material to a surface coated therewith and is particularly directed to the provision of an improved apparatus for accomplishing such measurement.

Among the various procedures that have been heretofore suggested for the determination of the adherence of a coating to a surface, the so-called scratching or gouging method appears to be the best in that the measurement obtained thereby most closely approximates the actual adherence of the coating to the surface. This procedure not only takes into account the adhesion of the material of the coating for the surface to which the latter has been applied but also the plastic resistance of the coating to flow, the tear resistance of the coating, and the like, all of which factors enter into the determination of the adherence of a coating to a surface.

The measurement of adherence by this procedure can be readily accomplished by means of an apparatus such as that described in the article "Eine Methode fuer die Haftfestigkeitspruefung von Anstrichfilmen" by Von W. Koenig appearing on page 1230 of "Farben Zeitung," volume 44 (December 30, 1939). This type of apparatus includes a carriage or support on which can be mounted a specimen of a surface having a coating whose adherence thereto is to be measured and provides an arrangement whereby the coating can be brought into opposing contact with a knife blade that acts to remove the coating or a portion thereof from the surface. Provision is also made for measuring the force required to so remove or strip the coating.

The adherence tester as described by Koenig utilizes a knife blade made of hardened steel. While the adherence of a coating to a surface can be more or less satisfactorily determined with such a knife blade, the cutting edge of the knife blade begins to curl and becomes useless after several strippings have been made therewith. Knife blades made of other metals fail in a similar manner. Apparently the crystalline structure of the metals permits the edge of the knife blade to chip too readily with the result that the blade becomes so weakened that it can no longer properly support its cutting edge.

Attempts to overcome this defect of hardened steel and other metals by the substitution of hard plastic materials therefor have been similarly unsuccessful in that the cutting edge of a knife blade made of such a material also becomes nicked and tends to curl after one or so measurements. This failure of knife blades made of such

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plastic materials appears to be due to their lack of microscopic structure and their consequent lack of the necessary strength to maintain the cutting edge in the required degree of thinness and smoothness.

It has now been discovered that entirely satisfactory operation of the Koenig-type adherence tester can be obtained and that the disadvantages of knife blades made of metals or plastic materials can be substantially eliminated by the use for this purpose of a material having a striated grain or structure. In accordance with the invention, the knife blade is formed of a natural substance having concentric striations or growth rings in such a manner that the cutting edge of the blade lies in a plane substantially perpendicular to the axis of such striations and also lies substantially along a radius thereof. Advantageously, ivory or a hard wood is employed in the fabrication of the knife blade.

The details of the present invention will be readily apparent from the following description thereof taken in connection with the accompanying drawing, in which:

Fig. 1 is a schematic elevation of a Koenig-type adherence-testing apparatus.

Fig. 2 is an enlarged view of a material having concentric striations, taken in a plane perpendicular to the axis thereof, and shows how the present knife blade is cut therefrom, the relation of the cutting edge with respect to the striations being indicated by the dot-dash line.

Fig. 3 is an enlarged perspective view of a knife blade prepared in accordance with the present invention, the relation of the striations to the configuration of the blade being indicated by the dotted lines.

With reference to Fig. 1, it will be observed that the adherence tester comprises a specimen-supporting unit S, a knife blade-supporting unit K, and a stripping force-measuring unit M.

As indicated, the specimen-supporting unit includes the carriage 10 on which a specimen 12 of a surface such as a metal having a film 14 of a coating material such as a paint, a lacquer, or the like, whose adherence to such surface is to be measured, can be suitably fastened as by clamps (not shown). Carriage 10 is mounted on the two brackets 16, 16, which are provided with threaded openings adapted to be engaged by the threaded spindle 18.

Mounted on one end of this spindle is the bevel gear 20, which engages the companion bevel gear 22 in turn mounted on the shaft 24 provided with the pulley 26. Power for driving

pulley 26 is furnished by the motor 28 and is transmitted thereto by means of the pulley 30, mounted on the motor shaft 32, and the belt 34.

The knife blade-supporting unit includes the beam 36 pivotally supported at one end by the beam 38 in turn pivotally mounted at 40. The other end of beam 36 is provided with the knife blade-holding means 42, in which is adjustably mounted the knife blade 44. Weight 46 is provided to maintain the knife blade in proper contact with the coated surface of the specimen 12.

Attached to the pivotally supported end of beam 36 is the wire 48, which is suitably attached at its other end to the wheel 50, of the stripping force-measuring unit, pivotally mounted on the support 52 and provided with the weighted pendulum 54. Integrally mounted on the wheel 50 is the cam 56, which activates the sliding arm 58 operating the scale 60.

In the testing of the adherence of a coating to a surface, a specimen thereof is fastened to the carriage 10 as indicated, and the knife blade 44 is placed in position to strip the coating from such surface. The motor 28 is started, and the carriage 10 is moved in the direction of the arrow 62. The knife blade-supporting unit is caused to move in the same direction, whereby the pendulum 54 is raised in the direction of the arrow 64. When the backward pull of the pendulum equals the forward thrust of the coated surface, then the knife blade begins to strip the coating from the surface, and the knife blade-supporting unit remains stationary.

The reading on the scale 60 is then an indication of the degree of adherence of the coating to the surface. To obtain the true measurement of the adherence, a second or blank run on the already stripped surface must be subsequently made, and the resulting purely frictional component deducted from the initial reading.

According to the present invention, the knife blade 44 is formed of a material having a striated grain or structure, preferably one in which the striations are concentrically arranged in a ring-like fashion. As indicated in Fig. 2, in the preparation of the knife blade, a striated material 66 of this type is cut in such a manner that the cutting edge 68 (shown in relative position by dot-and-dash line 68a) can be subsequently formed so that not only will it lie in a plane substantially perpendicular to the axis of the striations 70 but also substantially along a radius thereof. The indicated relation of the striations 70 to the configuration of the knife blade, especially the cutting edge thereof, is clearly indicated in the perspective view in Fig. 3.

Formation of the knife blade with the cutting edge in the indicated relation to the concentric striations is necessary for successful and prolonged operation. Such a knife blade can be utilized indefinitely with only an occasional resharpening of the cutting edge because of the normal dulling thereof and without any noticeable chipping or curling of the cutting edge. As many as 30 or more strippings (as compared with the two or three possible with a hardened steel knife blade) have been made with such a blade before resharpening of the cutting edge was deemed necessary.

On the other hand, if the cutting edge is formed substantially parallel to the striations themselves (as, for example, parallel to the edge 72 of the knife blade), then it readily chips and soon becomes useless. Similarly, the cutting edge easily curls and chips and is generally un-

satisfactory if it is formed substantially parallel to the axis of the striations.

It should be noted in this connection that satisfactory operation of this type of adherence tester also requires that the material of which the knife blade is made be softer than the substance of the base on which the coating composition is applied but harder than the coating composition itself. In other words, the knife blade should be sufficiently soft so that it does not cut or dig into the base and, at the same time, sufficiently hard so that it can effectively strip the coating from the base.

Materials admirably suited for this purpose comprise those natural substances having concentric striations or growth rings. Animal ivory, particularly elephant ivory, has been found especially advantageous in the stripping of a film of a lacquer or a paint from a base made of a metal such as steel; for not only does it possess the requisite striated grain or structure but it also combines therewith the necessary degree of hardness. Satisfactory results have also been obtained with various hard woods such as mahogany, boxwood, and ebony.

Successful use of the Koenig-type adherence tester has been possible only with a knife blade made of such a striated material and having its cutting edge formed in the indicated manner. Apparently, because of its striated grain or structure, such a material possess sufficient strength to resist deformation and to prevent curling of the cutting edge under the pressure to which the knife blade is subjected during use. No other type of material has been found at all practically satisfactory, a material of a crystalline nature, as previously pointed out, chipping and curling after only several strippings and a material of an amorphous nature being substantially useless.

An apparatus of this type is a particularly useful analytical tool for the comparison of the adherence characteristics of various coating materials. It is also especially useful as a research tool in the evaluation of the properties imparted to a coating material by the several ingredients included therein.

What is claimed is:

1. In a device for measuring the adherence of a film of an organic coating material to a surface coated therewith, said device comprising a support on which to mount a specimen of a surface coated with such a film, a holder for a knife blade, means to bring the knife blade and the film into opposing contact, and means to measure the force required to strip the film from the surface; a knife blade formed of a natural substance having concentric striations or growth rings, the cutting edge of the blade lying in a plane substantially perpendicular to the axis and also lying substantially along a radius of such concentric striations or rings, said striated substance being softer than said surface but harder than said coating material.

2. The device as claimed in claim 1, in which the natural substance forming the knife blade comprises animal ivory.

3. The device as claimed in claim 1, in which the natural substance forming the knife blade comprises a hard wood.

4. The device as claimed in claim 3, in which the hard wood comprises mahogany.

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(References on following page)

2,498,265

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

| Number    | Name           | Date          |
|-----------|----------------|---------------|
| 2,279,264 | Hoffman        | Apr. 7, 1942  |
| 2,373,200 | Simmons et al. | Apr. 10, 1945 |

5

6

FOREIGN PATENTS

| Number  | Country | Date          |
|---------|---------|---------------|
| 682,420 | Germany | Oct. 14, 1939 |

OTHER REFERENCES

An article entitled "Eine Methode fuer die Haftfestigkeitspruefung von Anstrichfilmen," by Koenig in Farben-Zeitung, vol. 44, pgs. 1230-1232.