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(54) **Apparatus for continuously forming and affixing labels to capsules.**

(57) There is disclosed a method of, and apparatus for, continuously forming and affixing labels to capsules, the apparatus (10) comprises:

a combined mould and conveyor means (12) defining a plurality of spaced-apart mould cavities (30) for forming the labels (18) therein;

a dispenser means (14) communicating with the combined mould and conveyor means (12) and adapted to discharge into one or more of the mould cavities (30) a quantity of flowable film-forming material (16) for forming one or more label;

a curing means (20) for curing the film-forming material (16) in one or more of the cavities (30), communicating with the mould and conveyor means (12), downstream of the dispenser means (14), to convert the film-forming material (16) into one or more label (18); and

a capsule transport means (22) defining a plurality of spaced-apart capsule-holding regions, the transport means (22) communicating with the combined mould and conveyor means (12) downstream of the curing means (20), and being adapted to move in registry with the combined mould and conveyor means (12) in a manner such that, in use, a label (18) in a cavity (30) is brought opposite to, and transferred to, a capsule (24) in a holding region.

A capsule produced by the method and/or apparatus will have substantially improved tamper-resistant and tamper-evident capabilities over capsules listed in the prior art.

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APPARATUS FOR CONTINUOUSLY FORMING AND AFFIXING
LABELS TO CAPSULES

The present invention relates to an apparatus
for continuously forming and affixing labels
5 to capsules, a method for continuously forming
and affixing labels to capsules, and to capsules
whenever produced by the apparatus or method
of the present invention.

Edible capsules comprising cap and body
10 parts which are telescopically joined, have
been in use in the pharmaceutical and food industries
for many years. Such capsules are generally
prepared from hydrophilic substances such as
gelatin, and are thus adapted to dissolve in
15 the intestines after ingestion.

A variety of capsule sealing techniques
and means have been developed over the years,
for the purpose of reducing the incidence of
accidental disengagement of the cap and body
20 parts, and the resulting premature release and
contamination of the contents. This problem
was considered in U.S. Patent No. 1,861,047,

which proposed to utilise a circular band of hardened gelatin to cover the seam that exists between the body portion and the cap portion, for the purpose of sealing the seam and for
5 indicating when the respective parts have become separated. This patent dealt not only with the accidental disengagement of the body part and cap parts, but also with the deliberate disengagement of the parts, usually for unauthorised
10 purposes, to alter or modify the capsule contents.

The problem of capsule tampering and adulteration has become critical in view of the recent, well publicised cases, in which cyanide was substituted for the capsule contents, and various
15 methods and means have been considered in an effort to provide an effective seal and tamper indicator. In addition to the approach taken in the above mentioned U.S. patent, it has been proposed to modify the dimensions of the cap
20 part of the capsule, so that it extends virtually to the end of the body part when the body part is fully inserted, so that the would be tamperer is unable to grasp the body part to pull it away from the cap part.

25 Attention has also been directed to the approach of applying an external seal that additionally functions as a tamper indicator. In our co-pending European patent application of even date we propose to apply adhesively
30 an edible label to the capsule wall so as to overlap the seam between the cap part and the body part. Such a seal serves to maintain the engagement of the cap part and the body part to each other, and, by its frangibility,
35 offers evidence of tampering by disintegration along the line of the capsule seam.

In the development of the aforementioned

invention, it became evident that commercial scale implementation of this method would require new techniques and correspondingly new apparatus. Thus, in the instance where the label is initially
5 formed and must thereafter be applied to the capsule, apparatus and corresponding techniques were not available efficiently to accomplish this task.

A variety of label manufacturing techniques
10 and corresponding apparatus do exist, which are capable of dispersing a plurality of labels for appropriate adhesive coating. Likewise, capsule handling apparatus is known which, for example, can advance capsules in consecutive
15 order through, for example, printing operations and packaging operations. There is, however, no apparatus or corresponding methodology for continuously and efficiently preparing the labels, and for affixing such labels to the capsules.

20 According to a first aspect of the present invention, there is provided an apparatus for continuously forming and affixing labels to capsules, which apparatus comprises:

a combined mould and conveyor means defining
25 a plurality of spaced-apart mould cavities for forming the labels therein;

a dispenser means communicating with the combined mould and conveyor means and adapted to discharge into one or more of the mould cavities
30 a quantity of flowable film-forming material for forming one or more label;

a curing means for curing the film-forming material in one or more of the cavities, communicating with the mould and conveyor means, downstream
35 of the dispenser means, to convert the film-forming material into one or more label; and

a capsule transport means defining a plurality

of spaced-apart capsule-holding regions, the transport means communicating with the combined mould and conveyor means downstream of the curing means, and being adapted to move in registry with the combined mould and conveyor means in a manner such that, in use, a label in a cavity is brought opposite to, and transferred to, a capsule in a holding region.

Preferably, the combined mould and conveyor means is rotatable about a single axis or about a plurality of generally parallel axes.

In the instance of a single axis of rotation, the combined mould and conveyor means comprises a circular drum with the cavities disposed at intervals along its outer circumferential surface. In the instance of a plurality of generally parallel axes the combined mould and conveyor means may comprise an endless conveyor belt rotatable about spaced-apart conveyor rollers, the endless conveyor having an upper surface with the cavities defined therein.

The dispensing means may be chosen from: means comprising a feed hopper which is disposed over the combined mould and conveyor means, the feed hopper having an opening adapted for alignment with, in turn, each of the succession of cavities to enable direct discharge thereinto of the film-forming material;

a roller system; and means comprising a spray assembly with a spray nozzle having an orifice positioned to discharge the film-forming material directly into, in turn, each of the succession of cavities.

The curing means is positioned for communication with a plurality of consecutive cavities.

Preferably, the curing means is chosen from:

means comprising a source of polymerization-initiating radiation;

means comprising a source of circulating air;

5 means comprising a provision for heating;
and

means comprising juxtaposed curing units, each unit directly in communication with a broad surface of the combined mould and conveyor means.

10 Heaters may be useful in the instance where the film material is a solution, emulsion or the like, to help volatilization of the carrying phase. The curing means may also, or alternatively, emit curing stimuli, for example, radio frequency
15 transmissions or actinic radiation, depending upon the composition of the film forming material. The apparatus may use cool circulating air as a curing means in the instance where the film forming material is a liquid at elevated temperature.

20 In the first aspect of the present invention the capsule transport means may make synchronous tangential contact with the combined mould and conveyor means, to enable a label to transfer to a capsule.

25 The capsule transport means is preferably chosen from:

means comprising a conveyor rotatable about a plurality of generally parallel axes;
and

30 means comprising a carousel rotatable about a single axis.

Thus, consecutive capsules may travel in a position which facilitates alignment with the combined mould and conveyor means, so that
35 prompt contact and transfer of one or more label in a cavity, to one or more capsule may be accomplished.

Preferably, the apparatus further includes

at least one rotating roller located for tangential contact and rotation against each consecutive capsule after transfer of the label to the capsule, the roller being positioned with its axis of rotation parallel to the longitudinal axis of the capsule, and the roller being adapted to ensure full adhesive contact between the label and the capsule.

Optionally, the apparatus may further include an adhesive applicator, located for communication with the labels in the mould cavities and positioned between the curing means and the capsule transport means, to dispense a quantity of adhesive formulation upon the broad surface of the labels that are to be applied against the capsules. This unit is optional, and its inclusion would depend upon the composition and state of the labels being applied.

The apparatus may be employed in the preparation of self-adhesive labels, including labels that do not require an adhesive coating. In such an instance, the curing means may comprise a dryer which is preset to produce a dried label which, nonetheless, has a slightly tacky upper surface enabling the label to be affixed to a capsule.

Alternatively, a self-adhesive label may be activated by the impingement, on the exposed surface of the label, of a blast of hot water vapour or steam. In such an instance, the hot water vapour or steam serves as an adhesive; nonetheless, the label treated in this manner can be considered self-adhesive.

According to the second aspect of the present invention, there is provided a method for continuously forming and affixing labels to capsules, which method comprises:

intermittently casting predetermined quantities

of a flowable film-forming material into consecutive, advancing mould cavities;

successively moving the mould cavities such that the cavities, filled with the film-forming material, move past a curing means to
5 substantially solidify the film-forming material, thereby to form the labels;

thereafter moving the mould cavities such that each cavity bearing a label is brought
10 consecutively into alignment and contact with one of the consecutive, advancing capsules; and

transferring and affixing the label to the capsule.

15 Preferably, the film-forming material is chosen from:

a liquid form, preferably selected from a dispersion, an emulsion and a solution; and
a composition comprising a hot melt.

20 The labels formed in the curing step are self-adhesive.

Alternatively, the method may further include applying a quantity of an adhesive to the exposed surface of a label within a cavity after the
25 cavity has moved past the curing means, wherein the adhesive is preferably pressure-sensitive, and preferably the adhesive is applied by spraying.

According to a third aspect of the present invention, there is provided a capsule, bearing
30 a label, whenever produced by a method of the present invention, or whenever produced by an apparatus according to the present invention.

The apparatus and corresponding method of the present invention are particularly well
35 suited for automatically applying and affixing tamper indicating labels across the seams of edible capsules, to make the capsules tamper-

resistant and tamper-evident. Suitable film-forming materials and adhesive formulations may be selected from those disclosed in our co-pending European patent application of even date.

5 The present invention provides an apparatus and corresponding method for automatically preparing and affixing labels to edible capsules. The present invention further provides an apparatus as aforesaid that offers commercial quality
10 and uniformity of product at higher speeds of continuous operation, than have been previously available.

For a better understanding of the present invention, and to show how the same may be carried
15 into effect, reference will now be made, by way of example, to the following drawings in which:

Figure 1 is a schematic plan view of one embodiment of an apparatus in accordance with
20 the present invention;

Figure 2 is a fragmentary perspective of a mould cavity in the combined mould and conveyor means in the apparatus of Figure 1;

Figure 3 is a schematic plan view showing
25 an alternative embodiment of an apparatus in accordance with the present invention;

Figure 4 is a fragmentary schematic plan view showing one embodiment of a curing means used in the apparatus of Figure 3;

30 Figure 5 is a fragmentary schematic view showing an embodiment of a capsule transport means, different from that shown in Figures 1 and 3; and

Figure 6 is a flow diagram of the basic
35 stages of a method of continuously forming and affixing labels to capsules, in accordance with the present invention.

Referring first to Figure 1, a representative assembly 10 is shown therein, which comprises a combined mould and a conveyor means 12, a dispenser means 14 shown communicating with the combined
5 mould and conveyor means 12 to discharge a quantity of flowable film forming material schematically illustrated as a spray 16. Spray 16, a film-forming material, subsequently cures to form labels e.g. 18 with the assistance of a
10 curing means 20, located downstream of dispenser means 14 and in communication with the combined mould and conveyor means 12. A capsule transport means 22 is located downstream of the curing means 20 and is adapted for tangential aligned
15 contact with the combined mould and conveyor means 12, to enable the labels 18 to transfer to a capsule 24.

The combined mould and conveyor means 12 as illustrated comprises a hollow cylinder or
20 drum 26 which has an outer circumferential surface 28 having defined therein a plurality of regularly spaced mould cavities 30 for (a) the reception of the film-forming material of the spray 16, and (b) the transport of the later formed labels
25 18.

Referring now to Figure 2, a mould cavity 30 is shown in fragmentary perspective. The mould cavity 30 defines an essentially flat floor surface 32 which defines the eventual
30 outer surface of the label 18. The mould cavity 30 includes a rim 34 which as illustrated herein is rectangular. It is to be understood, however, that the present invention is not limited to the shape of the cavity 30 as illustrated, but
35 also encompasses square, rectangular and round label shapes.

Referring again to Figure 1, the drum 26

is adapted to rotate about a single axis 36,
and the drum passes from the dispenser means
14, comprising as illustrated a spray nozzle,
to the curing means 20 which comprises a schematic
5 representation of complementary juxtaposed dryers
38. The dryers 38 may utilize heating means,
air circulating means or both, depending upon
the nature of the film-forming material in its
uncured state and the appropriate treatment
10 needed to effect curing.

For example, in the instance where film-
forming material 16 comprises a radiation-
polymerizable synthetic resin, the curing means
20 (of Figure 1) may appear as illustrated in
15 Figure 4, wherein a radiation-emitting unit
40 utilizes, for example, a plurality of lamps
42 to provide the necessary level of radiation
to encourage initiation of polymerization of
the film-forming material. This type of unit
20 is useful in the instance where the film-forming
material cures by a free-radical mechanism.
The intensity and duration of the radiation
can determine the extent to which polymerization
or curing takes place, so that one can control
25 the extent of polymerization.

Alternatively, the curing means 20 may
utilize paired, juxtaposed units similar to
the unit 40, however, with heat lamps or other
heat radiating means (not shown), to cause a
30 curing or hardening of the film-forming material
deposited, for example, as an emulsion. Thus,
the exposure to heat will cause the solvents
or carriers, to volatilise, leaving the hardened
film in the form of the label 18.

35 The curing means 20 may also comprise a
single chamber, or paired, juxtaposed chambers,
having an air-circulation means (not shown),

for the purpose of hardening those film-forming materials that are liquid at elevated temperatures. Thus, in the instance where the film-forming material is deposited as a hot-melt, the exposure
5 to a current of air, even at room temperature, will accelerate the hardening of the film-forming material into the final label.

Yet further, the curing means 20 may comprise a combination of air-circulation and heat, to
10 enhance evaporation and volatisation in the instance where the film-forming material contains a substantial solvent component.

The exact curing apparatus is thus seen to vary with the choice of film-forming material
15 employed in the present invention, and the curing means 20 is thus intended to encompass all such variations in curing technique within its scope. As the particular elements of a given curing means are otherwise known in the art, further
20 detail and diagrams thereof are not believed necessary herein.

Referring again to Figure 1, the capsule transport means 22 is disposed for tangential contact with the combined mould and conveyer
25 means 12 as shown, to enable the labels 18 to transfer to the outer surface of the capsules 24. In particular, the capsule transport means 22, as illustrated, comprises a carousel rotating about a single axis that rotates
30 synchronously with the drum 26, to permit the capsules 24 to register into alignment and contact with the cavities 30 as shown.

Referring briefly to Figure 5, an alternative capsule transport means 44 is shown which comprises
35 an endless belt 46 adapted for the regularly spaced support and transfer of capsules 18 as shown. The belt 46 rotates about pulleys or

wheels 48 and co-acts with the combined mould and conveyor means 12 illustrated fragmentarily.

In similar fashion, the combined mould and conveyor means 12 may rotate about a plurality
5 of generally parallel axes, as shown in Figure 3. Thus, the combined mould and conveyor means 12 comprises an endless belt 50 adapted to rotate about conveyor rollers 52 and 54 as shown. It can this be visualised that the transport
10 means 44 and the conveyor-type combined mould and conveyor means 12, could operate almost parallel to each other, however at a sufficient angle to permit the aligned synchronous tangential contact necessary to permit the labels 18 to
15 transfer efficiently to the surfaces of the capsules 24. Naturally, the exact positioning of the combined mould and conveyor means 12 with respect to the capsule transport means, whether constructed as in 22, or as in 44, is
20 discretionary and may vary in accordance with the specific needs and applications of the particular assembly under consideration.

With further reference to Figure 3, an alternative dispenser means 56 is shown, which
25 comprises a hopper containing a quantity of flowable film-forming material 58. While illustrated schematically in contact with the upper surface of conveyor belt 50, it is to be understood that hopper 56 is appropriately
30 positioned with an orifice (not shown), positioned in alignment with consecutive mould cavities to facilitate the discharge of predetermined quantities of the film-forming material 58 thereinto.

In similar fashion the curing means may
35 vary depending upon the installation or assembly contemplated. The curing means 60, while perhaps varying as to its operative components, is visually

different from the curing means 20 in Figure 1, by its linear passageway for the mould cavities 30. The curing means 60 may thus comprise a radiation source, a heater, an air blower, or any combination thereof appropriate for the curing of a particular film-forming material. The exact combination of equipment within the curing means, as mentioned earlier, is not critical and may vary within the scope of the present invention.

Referring again to Figures 1 and 3, the capsules 24, after receiving labels 18 may then pass in tangential contact with rotating rolls 62. The rolls 62 are positioned with their axes of rotation parallel to the longitudinal axis of the capsules 24, and are adapted to cause the rotation of the capsules 24 while supported on the capsule transport means 22 for the purpose of assuring that the label 18 is in uniform adhesive contact with the outer wall of the capsule. Thus, as illustrated by the motion arrows in Figure 1, rolls 62 cause the rotation of consecutive capsules 24 after they have received labels 18, as a last post-treating step thereof. While the presence of rolls 62 and the corresponding treatment step are contemplated, they may be optional, as full transfer and adhesion of label 18 may be achieved at the initial contact with capsule 24 at the tangent point between the combined mould and conveyor means 12 and the capsule transport means 22.

In some instances, label 18 is desirably coated with an adhesive prior to being transferred to capsule 24. Accordingly, an optional unit may be included in the assembly 10 to facilitate the continuous and automated application of

the adhesive as part of the preparation of the label 18. Referring again to Figure 1, an adhesive applicator 64 is shown which in this illustration comprises a spray nozzle. The exact type of applicator may vary, and as shown in Figure 3, may comprise a combined reservoir and brush unit 66. In either case, a predetermined quantity of adhesive may be dispensed upon the upper surface of the label 18, to enhance its adhesive affinity for the capsule 24.

The application of adhesive naturally varies with the type of adhesives and the type of film-forming materials utilised in the present invention. Generally, film-forming materials may include most hydrophilic polymers, capable of dissolving after ingestion. Similarly, the adhesive is desirably hydrophilic, and suitable adhesives should be accordingly selected.

Exemplary film-forming materials include natural proteins, cellulose and its derivatives, carbohydrates, vinyl polymers, acrylic polymer, natural gums and mixtures. Adhesives may be chosen from a broad group of materials as well, ranging from water and steam, to aqueous acidic buffer solutions, aqueous solutions of lower alcohols, aqueous alkaline solutions of natural proteins, cellulose derivatives, carbohydrates and synthetic polymers, the foregoing are merely representative examples. A more complete listing of adhesives can be gained from a review of our co-pending European Patent Application No. 83305331.7 and our co-pending European patent application of even date (PD-3076).

With respect to the adhesives, it is to be noted that certain film-forming materials may be prepared into labels that may be characterized as self-adhesive, as known in the art. Such

labels may be prepared with a pressure-sensitive adhesive, which may be applied as shown herein and which will offer an adhesive affinity to the outer surface of the capsule. Similarly,
5 the labels may have a surface thereof sensitised to offer the same adhesive affinity, whereby the label may be said to be self-adhesive, as well. Sensitisation of this latter label may be accomplished, for example, by the exposure
10 of a surface of the label to steam, to render that surface tacky and thereby adhesively receptive. Naturally, the present invention contemplates all types of adhesive labels within its scope.

The present invention also relates to a
15 method of continuously preparing and affixing of the labels to the capsules. The method is set forth in the block diagram of Figure 6. Referring thereto; the method commences with the casting of a predetermined quantity
20 of the film-forming material into consecutively advancing mould cavities of the combined mould and conveyor means. Thereafter, the mould cavities bearing the film-forming material are transferred to the curing means where the film-
25 forming material is appropriately cured to form the labels. The next step in the method comprises moving the mould cavities holding the labels as formed into alignment and contact with consecutively advancing capsules, in the manner illustrated
30 in Figures 1 and 3 herein, where such capsules are conveyed by a capsule transport means. At this point, the labels transfer from the mould cavities to the surface of the capsules and, in most respects, the affixation of the
35 labels is then complete. As mentioned earlier, a further optional step in the present method may comprise the rotation of the capsules against

rollers such as rollers 62, in Figure 1, to secure the labels in position on the capsule walls.

Figure 6 indicates that an optional step
5 in the present method comprises the application of adhesive to the labels after curing and before they are transferred to the capsules. As mentioned above, the employment of this step in the present method will depend upon the composition and operation
10 of the film-forming materials comprising the labels.

it can be seen from the foregoing discussion that the present apparatus and corresponding method offer an efficient, integrated scheme
15 for the affixation of labels to capsules, which possesses great commercial value. The present apparatus and corresponding method are particularly relevant and valuable, in view of the desire to place indicator labels upon edible capsules,
20 to render such capsules tamper-resistant and tamper-evident.

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CLAIMS:

1. An apparatus for continuously forming and affixing labels to capsules, which apparatus comprises:

5 a combined mould and conveyor means defining a plurality of spaced-apart mould cavities for forming the labels therein;

a dispenser means communicating with the combined mould and conveyor means and adapted
10 to discharge into one or more of the mould cavities a quantity of flowable film-forming material for forming one or more label;

a curing means for curing the film-forming material in one or more of the cavities, communicating
15 with the mould and conveyor means, downstream of the dispenser means, to convert the film-forming material into one or more label; and

a capsule transport means defining a plurality of spaced-apart capsule-holding regions, the
20 transport means communicating with the combined mould and conveyor means downstream of the curing means, and being adapted to move in registry with the combined mould and conveyor means in a manner such that, in use, a label in a cavity
25 is brought opposite to, and transferred to, a capsule in a holding region.

2. An apparatus according to Claim 1, wherein the combined mould and conveyor means is rotatable about a single axis or about a
30 plurality of generally parallel axes.

3. An assembly according to Claim 1 or 2, wherein the combined mould and conveyor means is chosen from:

means comprising a circular drum with the
35 cavities disposed at intervals along its outer circumferential surface; and

means comprising an endless conveyor belt

rotatable about spaced-apart conveyor rollers,
the endless conveyor belt having an upper surface
with the cavities defined therein.

4. An apparatus assembly according to
5 Claim 1, 2 or 3, wherein the dispenser means
is chosen from:

means comprising a feed hopper which is
disposed over the combined mould and conveyor
means, the feed hopper having an opening adapted
10 for alignment with, in turn, each of the succession
of cavities to enable direct discharge thereinto
of the film-forming material;

a roller system; and

means comprising a spray assembly with
15 a spray nozzle having an orifice positioned
to discharge the film-forming material directly
into, in turn, each of the succession of cavities.

5. An apparatus according to any preceding
claim, wherein the curing means is positioned for
20 communication with a plurality of consecutive
cavities.

6. An apparatus according to any preceding
claim, wherein the curing means is chosen from:

means comprising a source of polymerization-
25 initiating radiation;

means comprising a source of circulating
air;

means comprising a provision for heating;
and

30 means comprising juxtaposed curing units,
each unit directly in communication with a broad
surface of the combined mould and conveyor means.

7. An apparatus according to any preceding
claim, wherein the capsule transport means makes
35 synchronous tangential contact with the combined
mould and conveyor means, to enable a label
to transfer to a capsule.

8. An apparatus according to any preceding claim, wherein the capsule transport means is chosen from:

means comprising a conveyor: rotatable
5 about a plurality of generally parallel axes;
and

means comprising a carousel rotatable about a single axis.

9. An apparatus according to any preceding
10 claim, further including at least one rotating roller located for tangential contact and rotation against each consecutive capsule after transfer of the label to the capsule, the roller being positioned with its axis of rotation parallel to
15 the longitudinal axis of the capsule, and the roller being adapted to ensure full adhesive contact between the label and the capsule.

10. An apparatus according to any preceding claim, further including an adhesive applicator
20 located for communication with the labels in the mould cavities, and positioned between the curing means and the capsule transport means.

11. A method for continuously forming and affixing labels to capsules, which method
25 comprises:

intermittently casting predetermined quantities of a flowable film-forming material into consecutive, advancing mould cavities;

successively moving the mould cavities
30 such that the cavities, filled with the film-forming material, move past a curing means to substantially solidify the film-forming material, thereby to form the labels;

thereafter moving the mould cavities such
35 that each cavity bearing a label is brought consecutively into alignment and contact with one of the consecutive, advancing capsules;

and

transferring and affixing the label to the capsule.

12. A method according to Claim 11, wherein
5 the film-forming material is chosen from:

a liquid form, preferably selected from a dispersion, an emulsion and a solution; and a composition comprising a hot melt.

13. A method according to Claim 11 or
10 12, wherein the labels formed in the curing step are self-adhesive.

14. A method according to Claim 11 or 12, further including applying a quantity of an adhesive to the exposed surface of a label
15 within a cavity after the cavity has moved past the curing means, wherein the adhesive is preferably pressure-sensitive, and preferably the adhesive is applied by spraying.

15. A capsule bearing a label, whenever
20 produced by a method according to any one of Claims 11 to 14, or whenever produced by an apparatus according to any one of Claims 1 to 10.

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