United States Patent

Bion

[15] **3,665,745**

[45] **May 30, 1972**

[54] PERFORATING APPARATUS AND PRODUCT

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[52] **U.S. Cl.** **72/186,** 72/325

[51] **Int. Cl.** **B21d 28/12**

[58] **Field of Search** 72/71, 186, 325, 204, 404; 29/6.1, 163.5

[56] **References Cited**

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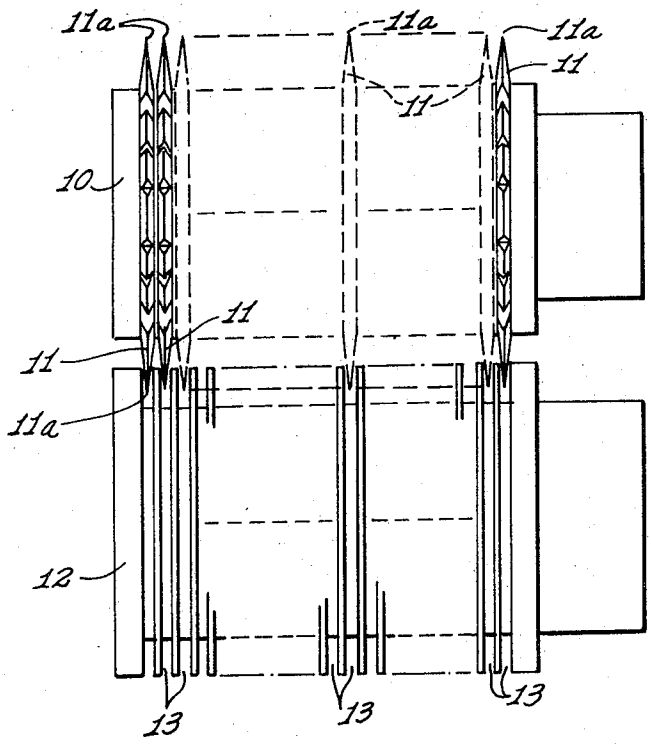
[57] **ABSTRACT**

Improved apparatus for perforating strip or sheet material is provided at high perforating speeds and with an economy of material; and which may be used for the inexpensive production of perforated soft ductile metal strips for grills, acoustic devices, and the like, for example, to cover the openings of cabinets of radio receivers and other apparatus, as well as for use in filter tubes, acoustic strip ceilings, or other structural applications. The apparatus comprises a driven roller and a freely rotatable roller positioned so that a strip of soft ductile metal, such as aluminum, may be drawn between the roller surfaces as the driven roller is rotated. The driven roller is provided with rows of teeth, and the free roller has corresponding peripheral grooves, the combination being such that when the strip is fed between the rollers, the teeth of the driven roller penetrate the strip and form horizontal and longitudinal rows of slots, shallow elongated V-shaped depressions.

2 Claims, 10 Drawing Figures



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3 Sheets-Sheet 1

Fig. 1

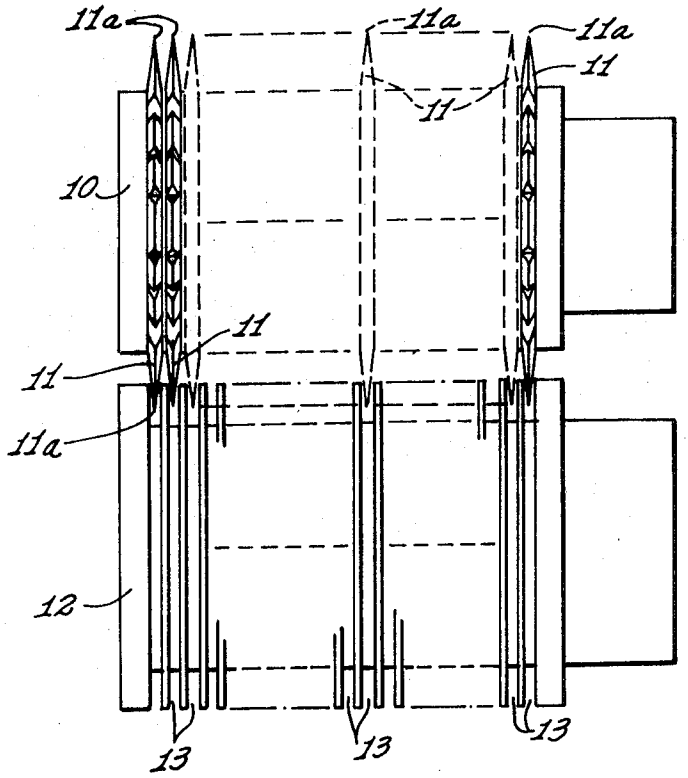

Fig. 2

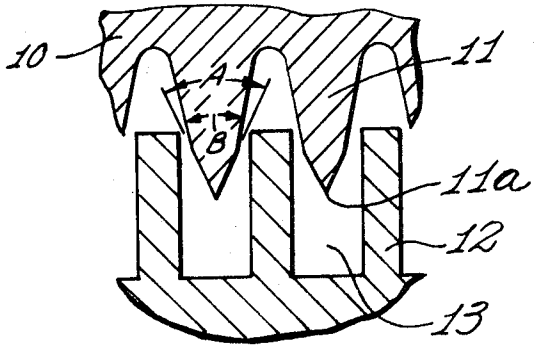

Fig. 3

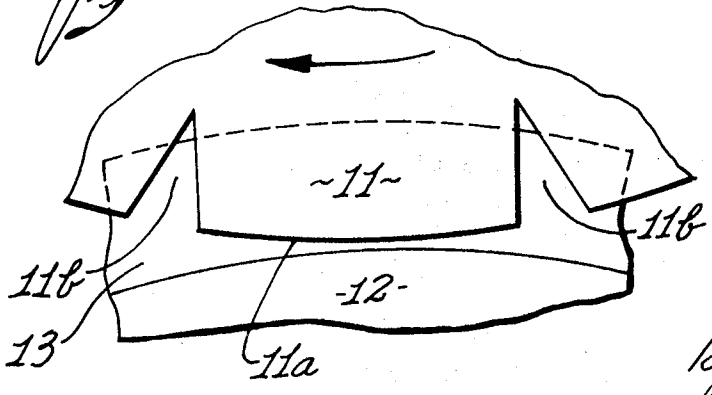

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Fig. 4

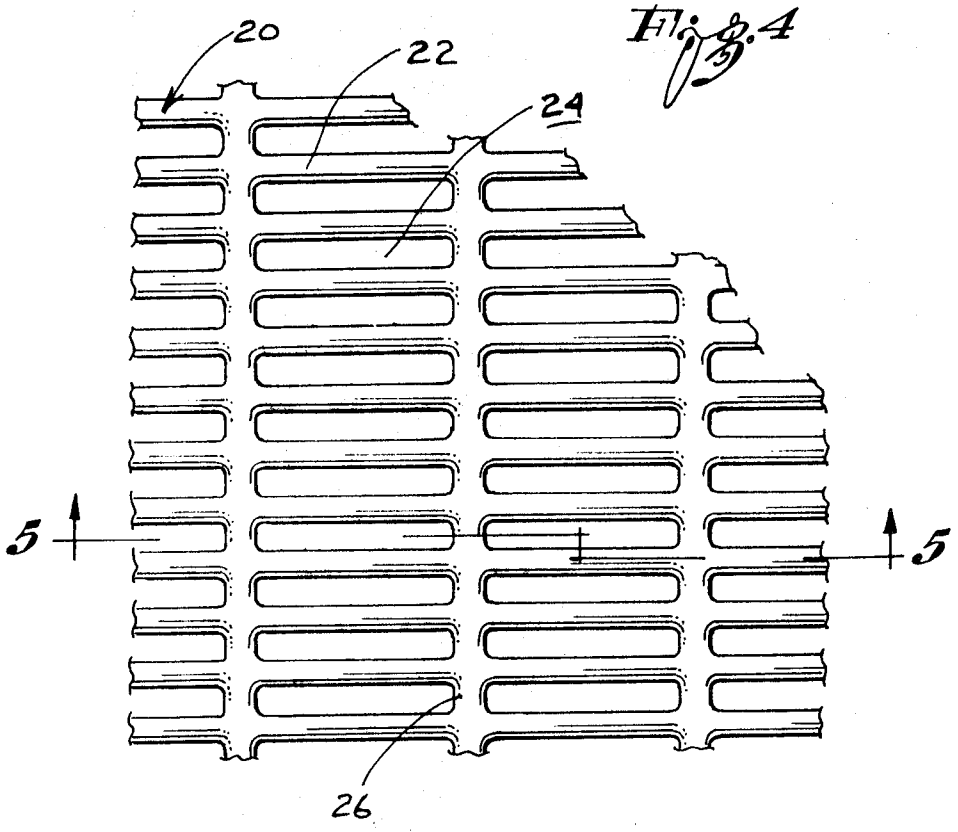

Fig. 5

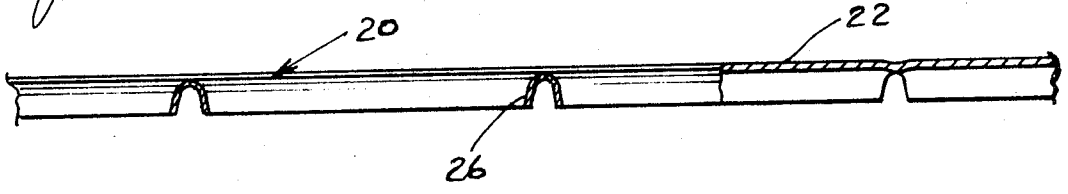

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FIG. 6

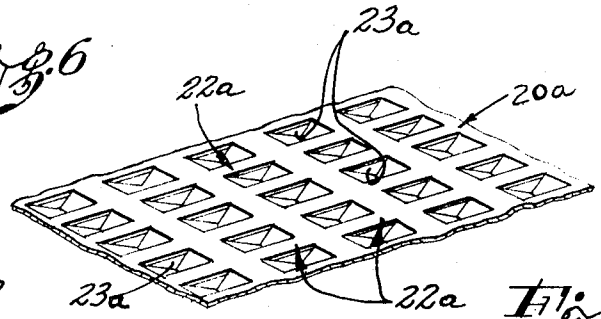


FIG. 7

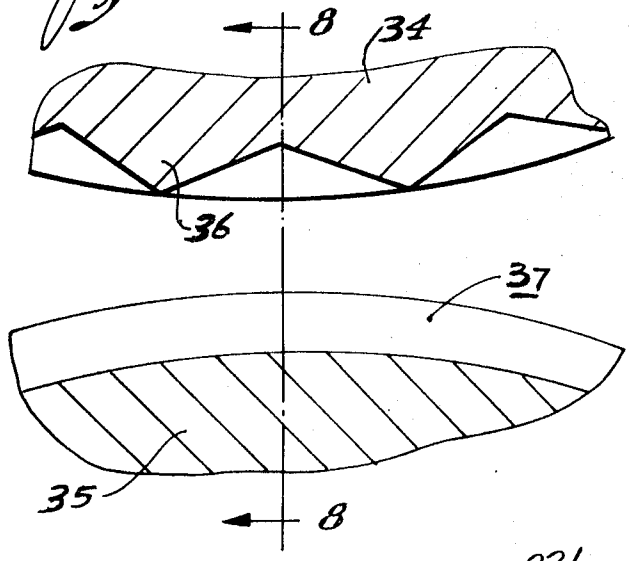


FIG. 8

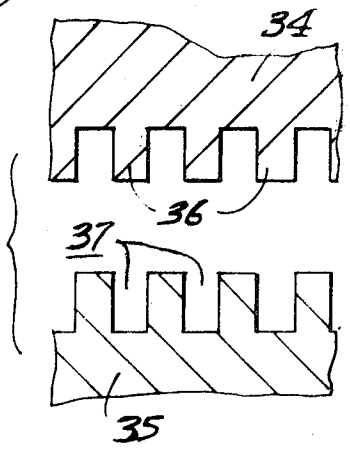


FIG. 9

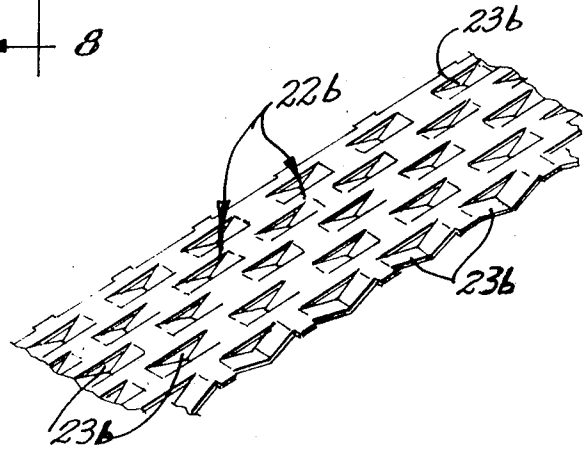
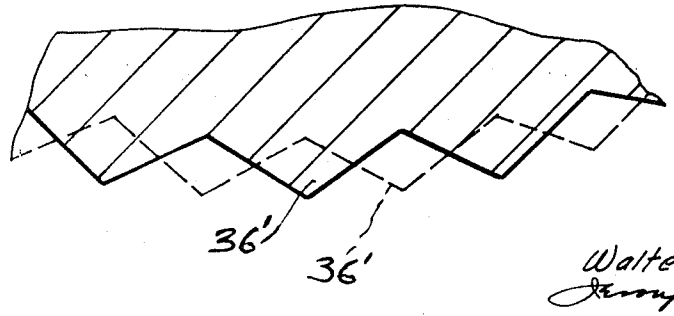


FIG. 10



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PERFORATING APPARATUS AND PRODUCT

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view showing the interrelationship of a driven roller and a freely rotatable roller which make up one of the embodiments of the improved apparatus of the present invention;

FIG. 2 is a fragmentary sectional view of an enlarged scale of the teeth and grooves in the rollers of FIG. 1;

FIG. 3 is an enlarged side view of one of the teeth shown in section in FIG. 2;

FIG. 4 is a plan view of a strip of perforated material which may be processed by the apparatus shown in FIGS. 1–3;

FIG. 5 is a section of the strip of FIG. 5 taken along the line 5—5 of FIG. 4;

FIG. 6 is a perspective view of a fragment of a strip of perforated material formed in accordance with a second embodiment of the invention;

FIG. 7 is a fragmentary representation of the driven roller and drive roller of the apparatus used to form the strip of FIG. 6, the rollers being shown in a fragmentary vertical section;

FIG. 8 is a vertical section of the rollers of FIG. 7 taken essentially along the line 8—8 of FIG. 7;

FIG. 9 is a perspective representation of a strip, similar to the strip of FIG. 6, but modified slightly as compared therewith; and

FIG. 10 is a vertical section of a driven roller which may be used to replace the driven roller of FIG. 7 in order to produce the strip shown in FIG. 9.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

The apparatus shown in FIGS. 1, 2 and 3, as mentioned above, is useful in producing perforated strips of the type designated 20 in FIGS. 4 and 5. The form of the teeth 11 on the driven roller 10 is such that the teeth penetrate the strip 20 which, as mentioned above, is formed of a soft ductile metal, or the like, so as to form rows of narrow slots and ribs extending along the strip, the slots being separated by rows of transverse ribs. The upper surfaces of the longitudinal ribs of the strip 12 are bowed upwardly, as shown in FIG. 5, for example, and the transverse ribs extend slightly above the plane of the strip and are also bowed to form ridges, as also shown in FIG. 6.

The teeth 11 of the driven roller 10 may be of a generally rectangular shape, as shown in FIG. 3; that is the teeth 11 are oblong with their circumferential dimension along the periphery of the roller 10. The teeth 11 have a cross-sectional shape such as shown in FIG. 0, so as to produce slots through the material of the strip 20 with transverse ribs or ridges to retain the strip as a unitary structure.

As shown, for example, in FIGS. 1–3, the teeth 11 of the driven roller 10 are positioned in equally spaced circumferential rows. The form of the teeth is shown in greater detail in the fragmentary views of FIGS. 2 and 3. For example, in FIG. 2, which is a transverse section, it will be seen that the teeth 11 taper to sharp edges 11a, while in FIG. 3, which is a side view, it will be seen that the edge 11a of each tooth has a slightly arcuate shape. The gap 11b between adjacent teeth 11 is of a V-shape. As shown in FIG. 1, for example, the teeth 11 are arranged in axially spaced, circumferential rows along the roller 10 to encompass a width corresponding to the width of the strip 20 of ductile material to be processed by the apparatus.

As shown in FIG. 2, the teeth 11 are tapered TO the sharp edges 11a, so that the apex of each tooth defines a relatively large angle a, while the root of each tooth defines a smaller angle B. The illustrated shape of the teeth 11 in FIG. 2 permits the larger angle at the tip of each tooth to perforate the material of the strip, and the sides of each tooth then to fold back the sides of the resulting perforation to provide a relatively large open area in each perforation in the strip, and also to provide for nearly vertical sides for each perforation.

The same effect as described in the preceding paragraph could be obtained if a very long single-angle tooth were used. However, when such a relatively long tooth leaves the perforation in the strip 20, it tends to pick up the transverse joining pieces of the strip and tears them. The effect of the double-angle tooth of FIG. 2 is to eliminate such a disadvantage. The general advantage of the tooth of FIG. 2 is that a perforated strip is produced which is stronger, due to the bending down and general deformation of the metal of the strip than a perforated plate of the usual flat type. This enables thinner material to be used in the apparatus of the invention with consequent economy.

The freely rotatable roller 12 as shown in FIGS. 1–3, for example, is formed with continuous circumferential grooves 13 spaced axially along the roller, the grooves 13 being spaced so that the teeth of each roll of the driven roller 10 enter a corresponding groove 13 in the freely rotatable roller 12, as best shown in FIG. 1. In operation, with the roller 10 being driven at a suitable speed of rotation, the strip 20 is fed between the rollers 10 and 12. The strip is picked up by the teeth 11 of the driven roller 10, which pierce the strip; the free roller 12 thereby being rotated by the moving strip. The parts of the teeth 11 which pass through the strip 20 are accommodated by the grooves 13 in the roller 12, with the strip being firmly supported by the peripheral surface of the free roller 12 between the grooves. However, roller 12 can also be driven, if desired.

In practice, the rollers 10 and 12 may be built up from discs suitably clamped together. In this way, perforations can be produced on the strip 20 either in a regular pattern; or the discs may be offset alternately in an angular relationship so as to produce a pattern of perforations in the strip in which the spaces between the slits are staggered. The length of the teeth 11 of the roller 10 also may be varied, so that a wide range of patterns may be produced.

The perforations formed in the strip 20, as shown in FIG. 4, for example, consist of transverse rows of thin slots, the rows being united at each end by transverse ribs which, as mentioned above, bows upwardly slightly. As shown in FIGS. 4 and 5, the strip 20 formed by the rollers of the apparatus described above has longitudinal ribs 22 spaced by slots 24, and it also has transverse ribs 26 between each transverse row of slots. In cross-section, and as shown in FIG. 5, for example, the ribs 22 are of an arched or channel configuration, and they are joined together at their ends by the transverse ribs 26 which likewise are arched or of channel form.

The embodiment of the apparatus shown, for example, in FIGS. 7 and 8 is used to produce strips of the type shown in FIG. 6. The latter apparatus forms the strip shown in FIG. 6, likewise, from an appropriate soft ductile metal strip, composed, for example, of aluminum. In the latter embodiment, the resulting perforated strip 20*a* has parallel rows of shallow elongated V-shaped depressions 23*a*, the depressions being formed by piercing the material at each side of each depression so as to leave slit-like openings in a plane perpendicular to the plane of the material and on either side of the longitudinal ribs 22*a*.

A fragment of a decorative grill is illustrated in FIG. 6 which is formed of a perforated soft ductile metal strip, composed, for example, of aluminum or the like. As clearly illustrated in FIG. 6, the strip 20*a* comprises parallel lines of shallow elongated V-shaped depressions 23*a*, and these depressions are formed, as mentioned above, by piercing the material so as to leave a slit-like opening at each side of each depression 23*a* and in a plane substantially perpendicular to the plane of the strip.

The apparatus for producing the strip of FIG. 6 is shown in fragmentary form in FIGS. 7 and 8. The apparatus shown in FIGS. 7 and 8 comprises a driven roller 34 and a freely rotatable roller 35 which their axes parallel and spaced apart so that the strip will be drawn between the roller surfaces when the driven roller rotates, as in the previous embodiment. The driven roller has circumferentially positioned spaced-apart

rows of shallow-elongated V-shaped teeth **36**, and, as before, the freely rotatable roller has corresponding peripheral grooves **37**. The assembly is such that when the strip of ductile material is fed between the rollers, the teeth of the driven roller deform the soft metal of the strip into V-shaped depressions which project from one face of the sheet. The teeth of the driven roller also serve to shear the material at each side of the depressions to form the aforesaid slit-like openings in the material.

In carrying out the operation described above, the teeth **36** of the driven roller **34**, and the material displaced from the plane of the strip of material as the shallow elongated V-shaped depressions are formed, enter the grooves **37** of the freely rotatable roller. The circumferential rows of teeth **36** in the driven roller are appropriately positioned so as to produce transverse parallel lines of shallow-elongated V-shaped depressions **23***a* in the material **20***a*.

The assembly is such that when the strip of ductile material is fed between the rollers **34** and **35**, the teeth **36** deform the soft metal of the sheet into the V-shaped depressions **23***a* of FIG. **6**, which are caused to project from one face of the sheet as the teeth **36** shear the material at each side of the depredssions to form the aforesaid slit-like openings. The teeth **36** and the material displaced by the teeth from the plane of the material of the sheet of FIG. **6** enter the grooves **37** in the freely rotatable roller **35**.

The circumferential rows of teeth **36** in the driven roller **34** may be appropriately disposed so as to produce transverse parallel lines of shallow elongated V-shaped depressions **23***a*, in the material as shown in FIG. **6**. Alternately, and as shown in FIG. **10**, the teeth **36'** of the circumferential row of teeth may be offset half a pitch from the adjacent row of teeth **36'**, so that the depressions **23***b* formed in one row in the material are offset from those in an adjacent row, as shown in FIG. **9**.

An alternative form of apparatus to that illustrated in FIG. **1**, however, could be obtained by using a pair of rollers geared together, and of identical form, and each having V-shaped teeth, with the teeth of one roller opposed to those of the other roller, so that the material has V-shaped depressions extending from both sides of the material and pointing in opposite directions.

The rollers shown in FIGS. **1**, **2**, **7** and **8** may be built up from discs suitably clamped together. The discs may be regularly or irregularly offset so as to produce patterns of depressions which are parallel or staggered transversely of the produced material. Also, the circumferential length of the teeth may be regular or irregular according to the pattern to be produced.

It will be appreciated that although particular embodiments of the invention have been shown and described, modifications may be made. It is intended, therefore, in the following claims to cover all such modifications as fall within the spirit and scope of the invention.

I claim:

1. Apparatus for perforating a strip of ductile material, comprising: a first roller mounted to be rotatably driven about a first axis, and a second roller mounted for rotation about a second axis parallel to and spaced from said first axis and in position such that the aforesaid strip may be drawn between the roller surfaces of said first and second rollers when said first roller is rotated; said first roller having circumferentially arranged spaced-apart rows of teeth, and said second roller having corresponding peripheral grooves for receiving the teeth of said first roller, so that when the strip of ductile material is fed between the rollers, the teeth of said first roller penetrate into the plane of the aforesaid strip and enter the grooves in said second roller so as to form horizontal and longitudinal depressions in said strip, each of said teeth having a double-angle V-shaped cross-section and having side surfaces which taper towards one another and terminate in a cutting edge, the angle included between said side faces adjacent said cutting edge being greater than the angle included between said side faces and the root of the tooth and the portion thereof adjacent said cutting edge, whereby the thickness of the tooth from the root thereof to adjacent said portion at said cutting edge tapers more gently than at said cutting edge where the angle between said side faces is greater.

2. The apparatus defined in claim **1**, in which said teeth of said first roller penetrates the aforesaid strip and pass through the strip and enter the grooves of said second roller thereby forming horizontal and longitudinal rows of slots in the sheet.

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