

March 12, 1957

A. A. NINA
SWITCH MECHANISM

2,785,256

Filed Oct. 18, 1952

3 Sheets-Sheet 2

FIG. 4

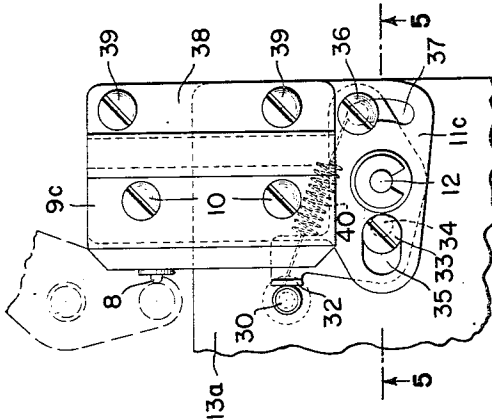


FIG. 5

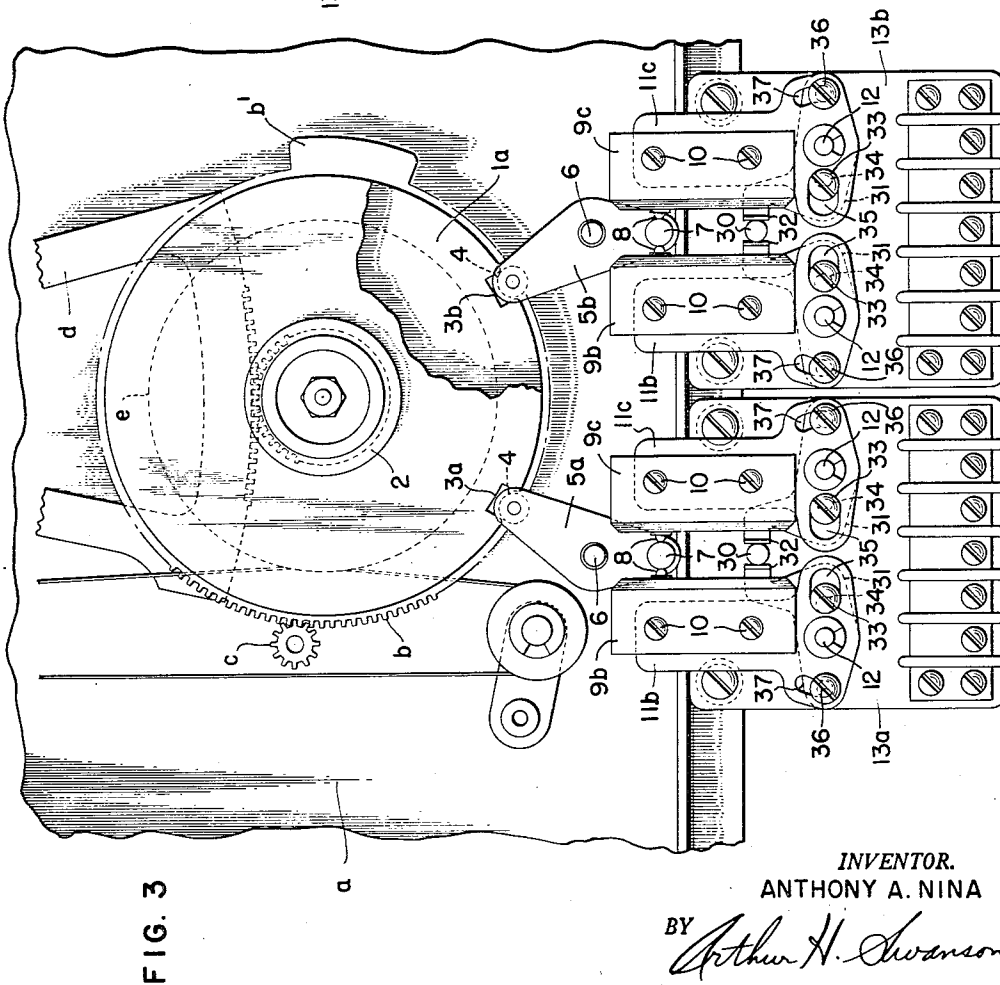
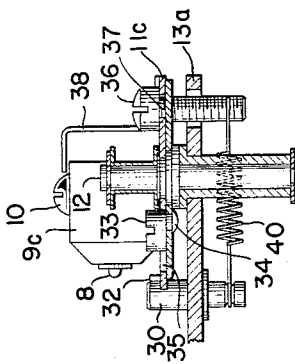


FIG. 3

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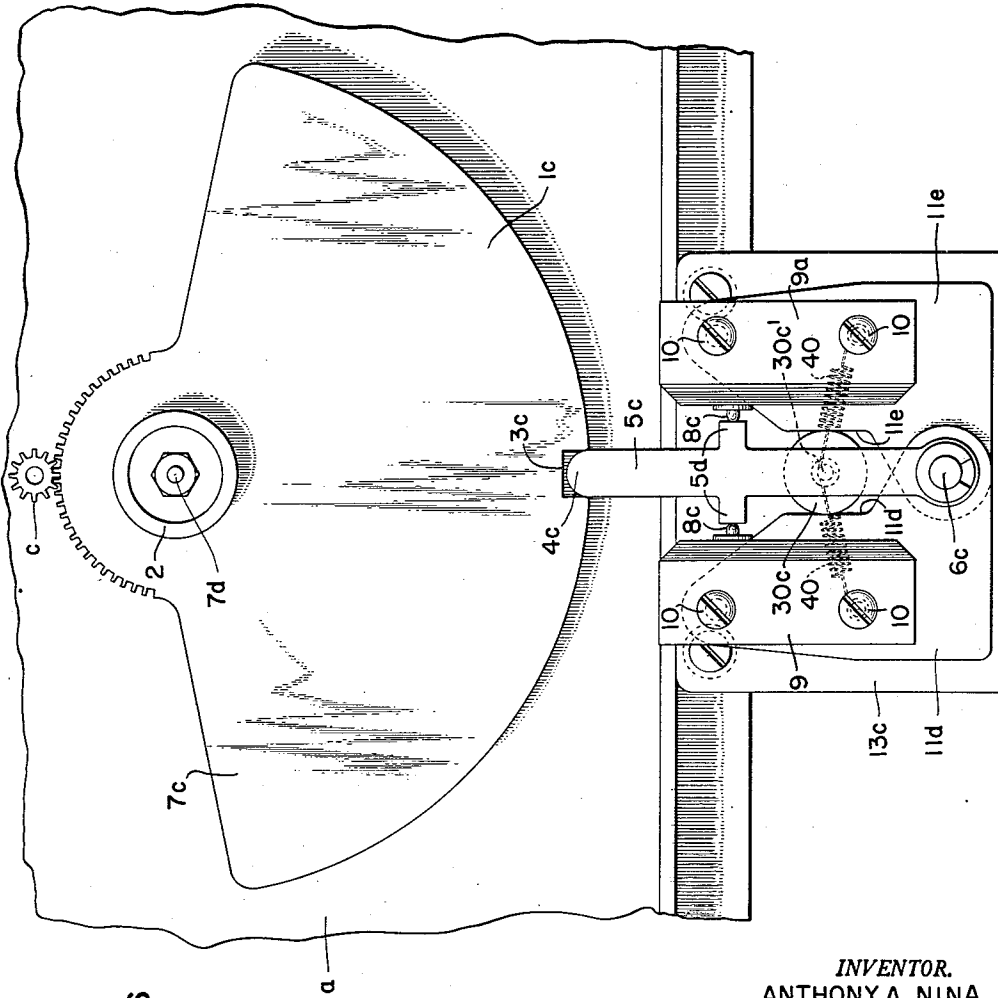
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2,785,256

SWITCH MECHANISM

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Application October 18, 1952, Serial No. 315,550

1 Claim. (Cl. 200—153)

The general object of the present invention is to provide a measuring and control instrument of well known type with an improved switch mechanism for producing control and signal effects in predetermined accordance with variations in a quantity measured.

More specifically, the object of the present invention is to provide a recording and control instrument of a type including a power actuated element oscillating on and in accordance with increases and decreases in a quantity measured.

A still more specific object of the invention is to combine a measuring and control instrument of the general type mentioned with one or more switches of a well known type characterized by their relatively small size and by the relatively small magnitude of the to and fro movements of the switch element and the actuating element required to adjust the switch between its open and closed position.

Another specific object of the invention is to provide a combination of the character mentioned including provisions for adjusting the actuating element of each switch associated with the oscillating element relative to a predetermined set point position, while further movement of the oscillating element will bodily adjust the switch out of a normal position relative to the control element into a position in which further movement of the element will have no effect on the position or condition of the switch.

The various features of novelty which characterize my invention are pointed out with particularity in the claim annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages, and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described preferred embodiments of the invention.

Of the drawings:

Fig. 1 is an elevation of a portion of a control instrument;

Fig. 2 is a partial section taken on the line 2—2 of Fig. 1;

Fig. 3 is an elevation illustrating a modification of the apparatus shown in Figs. 1 and 2;

Fig. 4 is an elevation illustrating a modification of the apparatus shown in Fig. 3;

Fig. 5 is a section on the line 5—5 of Fig. 4; and

Fig. 6 is an elevation illustrating still another modification of the apparatus shown.

The apparatus shown in Figs. 1 and 2 comprises an instrument frame member *a* on which a spur gear *b* is mounted for rotation about its axis. A reversibly rotatable pinion *c* is journaled on the frame member *a* and has its teeth in mesh with the teeth of the spur gear. A gear sector *d* pivoted on the frame member *a* is arranged to turn about an axis displaced from the gear *b* but parallel to the axis of that gear. The gear sector *d* has its gear teeth in mesh with the teeth of the gear *b*

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Coaxial with and attached to the gear *b* is a cable drum *e* about which a flexible cord or wire is wound.

Insofar as above described, the apparatus shown in Figs. 1 and 2 are identical with parts of the well known and widely used potentiometric self-balancing measuring and control instrument disclosed and claimed in the Wills Patent 2,423,540 of July 8, 1947. In that instrument the pinion *c* is rotated on and in accordance with the magnitude and direction of change in the value of the quantity measured. The rotative movement of the gear *b* is restricted to something less than 360° in each direction by a projection *b'* from the gear *b*. The projection *b'* is adapted to interrupt the rotation of the gear *b* when it engages the pinion *c* or some other stop. The gear sector *d* is adapted to oscillate an indicator element on and in accordance with variations in the quantity measured and may also serve control purposes. In the type of instrument disclosed in the Wills patent, the cable *e'* is employed primarily to move the wiper contact along a slide wire resistor included in the measuring circuit. The apparatus shown in Figs. 1 and 2, insofar as it has been described, is not claimed as novel per se herein, but is well known apparatus of a type which may advantageously be combined in accordance with the present invention, with the switch mechanism hereinafter described.

The switch mechanism disclosed in Figs. 1 and 2 includes a cam disc 1 coaxial with and mechanically connected to the gear *b* for rotation with the latter. As shown, the disc 1 is normally attached to the gear *b* by a threaded clamping device 2 which can be backed off to release the cam and permit its angular adjustment relative to the gear *b*. The cam 1 is formed with a peripheral notch 3 which normally receives a pin or projection 4 carried by the free end of one arm of a bell crank lever 5 which is pivotally connected to the frame *a* by a pivot 6. The diameter of the projection 4 is equal to the width of the notch 3. The second arm of the bell crank lever 5 carries an actuating pin 7 at its free end. In the normal balanced condition of the apparatus, the plane including the axes of the pin 4 and pivot 6 intersects the common axis of the disc 1 and spur gear *b*. As shown in Fig. 1, the pin 7 is between and in contact with the similar juxtaposed actuator elements 8 of two switch members 9 and 9a. Those switch members are of a well known and widely used type, each including mechanism for opening and closing an electric circuit on a small linear movement of the corresponding actuator element 8. Each element 8 has a portion within the corresponding switch structure and an exposed outer end portion extending out of said structure through an opening in its wall as shown in Fig. 1. Each element 8 is biased to project from the switch structure of which it forms a part to the extent shown in Fig. 1. In its neutral or set point position shown in Fig. 1, the actuator pin 7 is between and in contact with the elements 8 of the two switch members, but applies no actuating force to either member 8.

As shown, the switch structures 9 and 9a are separately connected by screws 10 to supporting plates or brackets 11 and 11' respectively. Each of the plates 11 and 11' is connected by an individual pivot 12 to a lower edge extension 13 of the frame member *a*. As shown, the upper end portion of the extension 13 is secured to the lower edge portion of the frame member *a* by means comprising spools or spacers *a'* having their axes perpendicular to the plates *a* and 13. A separate clamping screw 14 extends through the extension 13 and each spool *a'*, and is in threaded engagement with the lower portion of the member *a*. In the condition of the apparatus shown in Fig. 1, each of the switches 9 and 9a is in its normal condition, i. e., is closed or open, depending on the switch pattern, since no pressure is then applied to the outer end of the pin 8.

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Each switch member 9 and 9a is biased for return movement toward the other into its normal or set point position shown in Fig. 1, when out of that position. When in those positions, the switches 9 and 9a abut against stops 15 and 16, respectively. The switch 9 is biased for movement into engagement with the stop 15 by a spring 17. The latter is coiled about a hub-like part 17' surrounding the corresponding pivot 12, and has end portions 18 and 19 extending tangentially away from said hub in opposite directions. The end portion 18 is connected to a pin 20 carried by the corresponding plate 11. The end portion 19 is connected to a pin 21 secured to the plate 13. The switch member 9a is similarly biased for movement into engagement with the stop 16 by parts 17a', 20' and 21', similar to the parts 17-21.

Advantageously, the bell crank lever 5 is biased for movement into its position shown in Fig. 1 by means similar to the above described means for biasing the switches 9 and 9a. Thus, as shown in Fig. 2, the pivot 6 extends into a transverse projection 22 from the frame member a and a bias spring 23 has its body portion wound around the hub 22. The end portions 24 and 25 of the spring 23 are biased to engage the opposite sides of a pin 26 connected to and extending transversely away from the frame member a alongside the projection 22. An arm 27 rigidly attached to the lever 5 extends between the spring terminals 24 and 25. The parts 26 and 27 are so proportioned that each engages both spring terminals 24 and 25 when the lever 5 is in its neutral position.

With the described arrangement, the control quantity may be a temperature, pressure or other quantity or condition measured, and is assumed to have a normal set value or point, so that the bell crank lever 5 normally occupies its set point position which is shown in Fig. 1. With the lever 5 so positioned, the biasing springs 17 and 17a' hold the switch members 9 and 9a in their respective positions shown in Fig. 1. On a departure of the actual value of the control quantity or condition from its normal value, the motor connected to the pinion c is caused to rotate the cam disc in the clockwise direction or in the counter-clockwise direction, depending on the direction of change of the control quantity or condition. The angular adjustment of the cam disc acts through the cam follower pin 4 to change the angular adjustment of the bell crank 5, and thereby actuate one or the other of the actuating elements 8 depending on the cam adjustment direction.

In some cases the initial movement thus given to one or the other of the contacts 8 may produce an immediate corrective change in the control quantity or condition, and a prompt return of the bell crank lever to its neutral or normal position. In other cases the change in the control quantity or condition which initiated the cam movement may not be promptly reversed, and may even increase during a considerable time interval. In such case, the pin 4 will be cammed out of the cam notch 3 by the rotative movement of the cam, and that movement may continue until the notch is angularly displaced from the pin 4 through a substantial angle. Ordinarily such displacement will eventually be followed by a reverse movement of the cam 1 which more or less gradually returns the cam to its normal position. In the course of such return movement, the cam follower 4 re-enters the notch 3 and returns to its normal position shown in Fig. 1.

The invention is characterized by the simplicity and effectiveness of the switching mechanism and by the relatively minute movement of the cam 1 necessary to move the corresponding actuating element 8 into the switch structure of which it forms a part, and thus change the switch condition. The minimum angular movement of the cam required to shift a switch between its open and its closed positions may be very small, and in some cases will be a small fraction only of the angular adjustment

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of the disc b quickly produced by the change in the quantity measured. After the cam movement is reversed, the switch will be reversely adjusted as soon as the cam returns to its normal or neutral position. The linear return movement of the actuating element 8 of each switch requires no greater angular movement of the cam than is required to effect its initial displacement.

In Figs. 1 and 2 the extension plate 13 supports a multiplicity of circuit connector screws 22 with the customary insulation walls interposed between the adjacent screw which may be at different potentials.

The invention may take forms other than the one shown in Figs. 1 and 2. As will be apparent, with either of the switch members 9 and 9a removed, the other switch member remains fully operative to respond to movements of the cam 1 away from its neutral position in one direction. Also a single cam may be used to actuate a multiplicity of switch members. Thus as shown in Fig. 3, a cam 1a which differs from the cam 1 of Figs. 1 and 2 only that it is formed with two angularly displaced notches 3a and 3b, is associated with two bell crank levers 5a and 5b. Each of said levers is individually operative to control one or the other of a separate pair of switch members 9b and 9c, as the cam 1a moves away from its neutral or set point position in one direction or the other. The lever 5a may be and, as shown, is a counter part of the lever 5. Its associated pivot and pin parts are designated by the same symbols 4, 6, and 7, as the corresponding elements associated with the lever 5. The lever 5b is similarly associated with pivot and pin parts 4, 6, and 7. In its neutral position, the supporting pivot 6 for the lever 5a, as for the lever 5, is directly above the associated pin 7 and associated pin 4, and is at the right of the plane including the axes of the pivot 6 and pin 7. The lever 5b differs similarly from the lever 5a and lever 5 in that its pin 4 is at the left of the vertical plane including the axes of the pivot 6 and pin 7 associated with the lever 5b. As shown in Fig. 3, the levers 5a and 5b are angularly displaced about the axis of the cam 1a through a substantial angle. That angle is shown as an angle of approximately 60°, but may be greater or much smaller as conditions make desirable. As shown, the two levers 5a and 5b and the cam notches 3a and 3b are so relatively disposed that when either lever is in its neutral position, the other lever is also in its neutral position. This relation is not essential, however, as the two levers and two notches may be so arranged that when the lever 5a is received in the notch 3a and is in its neutral position, the lever 5b will be displaced in one direction or the other from the notch 3b.

The switches 9b and 9c are connected to corresponding supporting plates or brackets 11b and 11c, respectively, by screws 10. The plates 11b and 11c for the switches 9b and 9c associated with the lever 5a, are connected by separate pivots 12 to an extension 13a of the frame member a. The extension 13a may be a counterpart of the extension 13 of Figs. 1 and 2. The switches 9b and 9c associated with the lever 5b, are connected by pivots 12 to an extension 13b of the frame member a. The extension 13b may be a replica of the extension 13a.

The movement of each switch of either pair of switches toward the other switch of the pair is arrested by a stop 30 between the two switches of the pair. Each stop 30 is perpendicular to, and supported by the corresponding extension plate 13a or 13b. The movement of each of the switches 9b and 9c toward the associated stop pin 30, is arrested when the latter is engaged by a transverse projection 32 from a plate 31 alongside and adjustably connected to the corresponding plate 11b or 11c.

As shown, each plate 31 is pivoted on the corresponding pivot 12, and the adjustable connection between that plate and the associated pin 11b or 11c comprises an eccentric disc 33 for angularly adjusting the plate 31 about the pivot 12 relative to said associated plate. Each

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eccentric disc 33 has its axis laterally displaced from the axis of its supporting shaft 34. The latter passes through and is journaled in the plate 31 which is beneath the associated plate 11b or 11c.

The eccentric disc 33 is received in a slot 35 formed in the associated plate 11b or 11c and elongated in a direction radial to the corresponding pivot 12. Each of the plates 11b and 11c is formed with a slot 37 extending circularly about the axis of the corresponding pivot 12. A separate screw 36 has its body portion extending through each slot 37 and in threaded engagement with the associated plate 31. The head of the screw 36 engages the outer side of the corresponding plate 11b or 11c. As will be apparent, the described arrangement permits the portion 32 of the plate 31 to be moved relative to the associated stop 30, as required to insure the proper neutral relation of each pin 7 and the associated switch actuating elements 8 when the pin 4 is in its neutral position. In a general way, it is immaterial which of the two slots 35 and 37 is more or less remote from the projection 32, and it is not essential that either of said slots be formed in the plate 11b or 11c, instead of in the associated plate 31.

Figs. 4 and 5 illustrate a modification of the apparatus shown in Fig. 3, including a Z-bar 38 above the associated plate 11c. As shown, the Z-bar 38 is parallel to the length of the adjacent switch member 9c, and is secured to the latter by spaced apart clamping screw 39. As shown, the web of the Z-bar is perpendicular to the adjacent plate 11c, and one rib portion of the Z-bar extends over the corresponding switch member 9c. The Z-bar gives added rigidity to the associated plate 11c. As shown in Figs. 4 and 5, the clamping screw stem 37 extends down through a slot in the associated plate 13a or 13b and forms an abutment between which and the depending lower end portion of the corresponding stop 30 a biasing spring 40 is connected. That spring serves to normally hold the corresponding projection 32 against the stop 30. The biasing spring arrangement shown in Figs. 4 and 5 may be used to bias each of the switch members 9b and 9c shown in Fig. 3, for movement into engagement with the corresponding stop 30.

In Fig. 6 I have illustrated, by way of example, a modification of the apparatus hereinbefore described, in which the cam 7c oscillated by a pinion C, is in the form of a disc segment having a central edge notch 3c. In the normal or neutral position of the apparatus shown in Fig. 6, a lever 5c of the second class has a rounded end 4c received in the notch 3c, and extends radially away from the cam 1c in a direction radial to the cam axis 7d. The lever 5c has its second end journaled on a pivot 6c. The latter may be supported by a plate 13c similar to the plate 13 of Fig. 1. Switch members 9 and 9a, which may be similar to the members 9 and 9a of Fig. 1, are located at the opposite sides of the lever 5c. The switch members 9 and 9a of Fig. 6 are mounted on, and connected by screws 10 to plates 11d and 11e, respectively. Each of

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those plates is journaled on the pivot 6c. The lever 5c may be biased as is the lever 5 of Fig. 1, to occupy the neutral position shown in Fig. 6, whenever permitted to do so by the position of the notch 3c. Each of the plates 11d and 11e is biased as by a connecting spring 40c for movement into their respective neutral positions in which the edge portions 11d' and 11e' engage the opposite sides of a spacer disc 30c. As shown, the spacer disc 30c may be supported by the plate 13 through a post 30c'.

In the contemplated use of the apparatus shown in Fig. 6, on movement of the lever 5c in either direction away from its normal position, the switch member toward which the lever moves remains stationary until its element 8c is given the small movement needed to effect an adjustment of the corresponding switch member. Thereafter that switch member moves with the lever 5c as though rigidly attached to the latter until the lever 5c returns to its normal position.

The various features of novelty which characterize my invention are pointed out with particularity in the claim annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages, and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described preferred embodiments of the invention.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

Means for actuating one or more electric switches, including, a spur gear mounted for oscillatory motion about an axis, a cam disc having a notch in the edge thereof, a clamping device securing said disc to said gear in adjusted position, a bell crank lever mounted for oscillatory motion about an axis parallel to the axis of said gear and outside of the periphery of said disc, one end of said lever engaging the periphery of said disc and being located in said notch when the means are in normal position, a spring biasing said lever towards engagement with said disc, a plurality of electric switches each having an actuator element projecting therefrom and engaging said lever, a plurality of supporting plates each having one of said switches attached to it and mounted for oscillatory motion about an axis parallel to the axis of said gear, a plurality of springs each biasing one of said plates toward the position in which the actuator element of the switch carried by said plate engages said lever, a plurality of stops each located in the path of travel of one of said plates so as to limit the movement of said plate under the bias of one of said springs.

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