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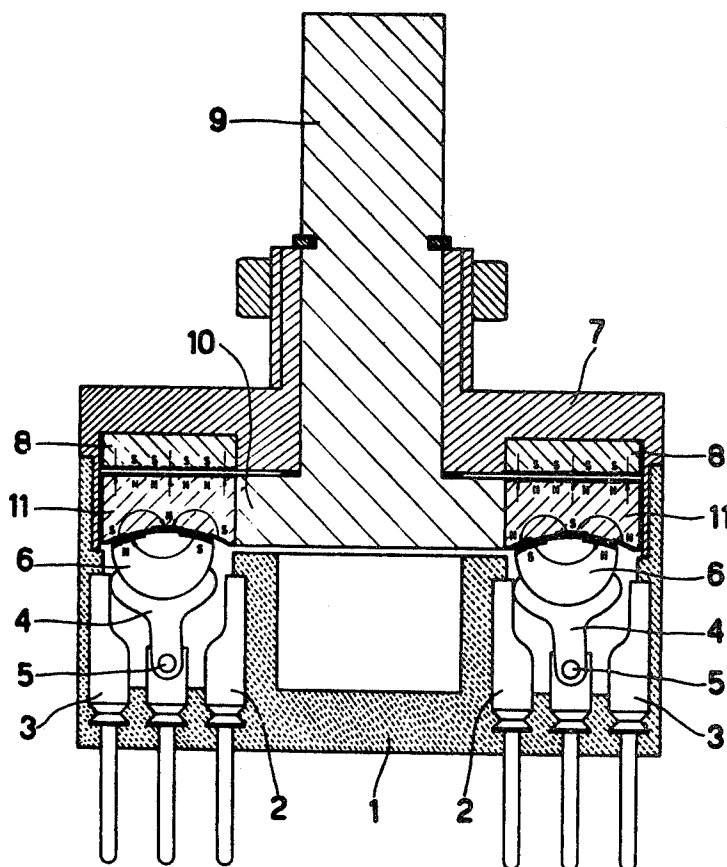
[54] **MAGNETIC ROTARY SWITCH**
3 Claims, 9 Drawing Figs.

[52] U.S. Cl. 335/207
[51] Int. Cl. H01h 5/02,
H01h 19/60
[50] Field of Search 335/205,
206, 207; 200/67 F

[56] **References Cited**
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ABSTRACT: Snap acting magnetic rotary switch having a plurality of switches, each of which comprising two fixed contacts and one movable contact, a permanent magnet being fast with the latter. The switch also comprises two annularly shaped permanent magnets adjacent each other and the magnets fast with said movable contacts, the annular magnet outwardly positioned being fixed and having as many pairs of poles as the switches and as many pairs of poles being provided on the adjacent surface of the intermediate annular magnet which is fast with a rotary shaft. On the surface of the intermediate annular magnet facing the magnets fast with the movable contacts three ring-shaped poles are provided, the sign of which being alternately different; one of these poles is interrupted at a location and the other two poles are deformed to this location. Upon rotation of said shaft, the switch contacts are snap opened or closed with a speed independent of the speed of rotation of said shaft.



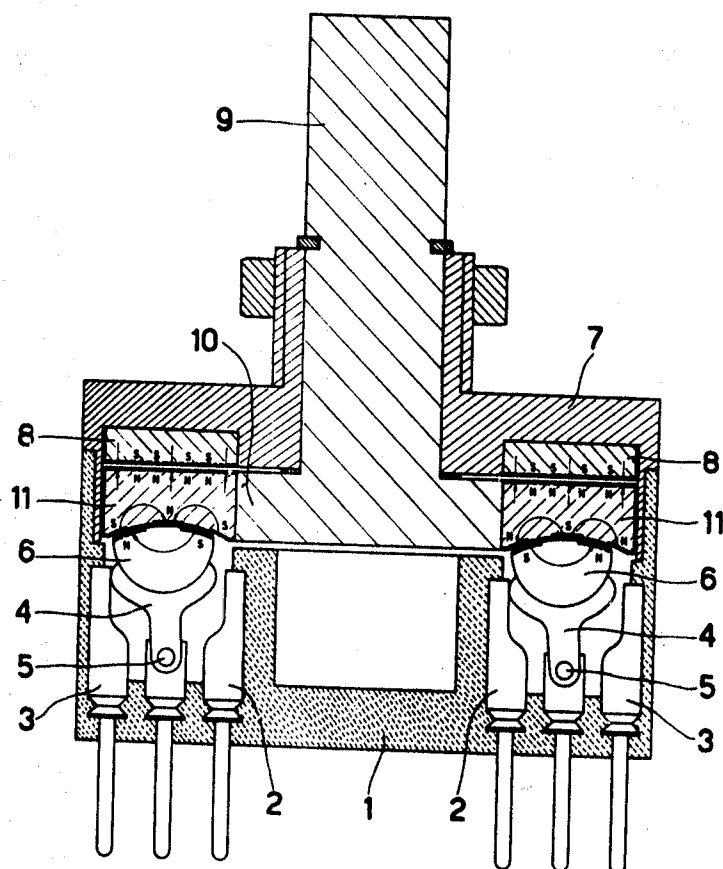


FIG. 1

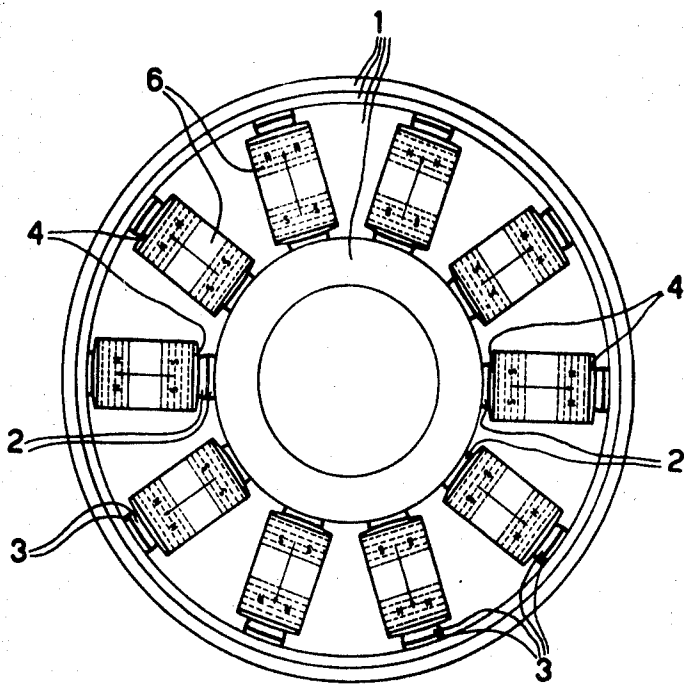


FIG. 2

FIG. 5

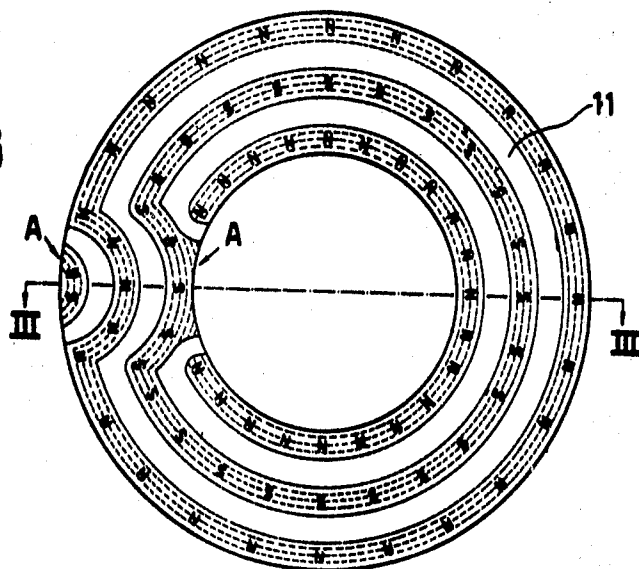


FIG. 3

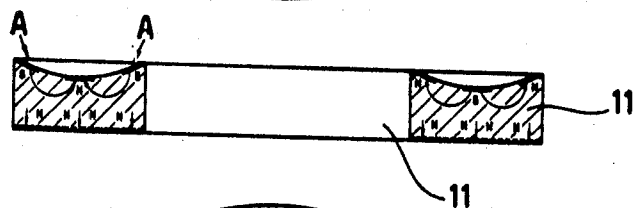
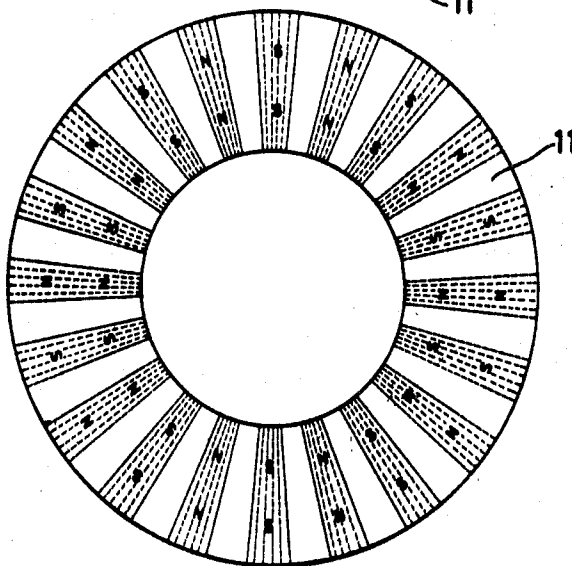


FIG. 4



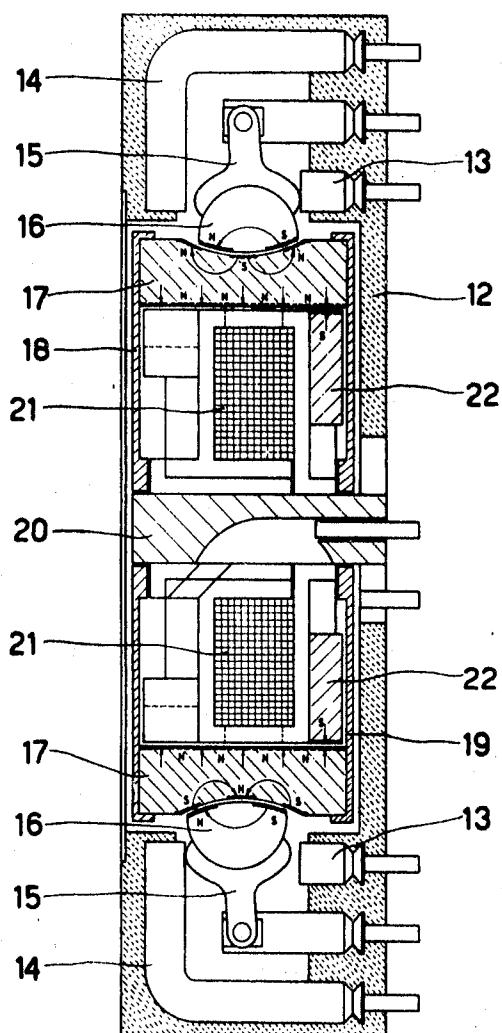


FIG. 6

FIG. 8

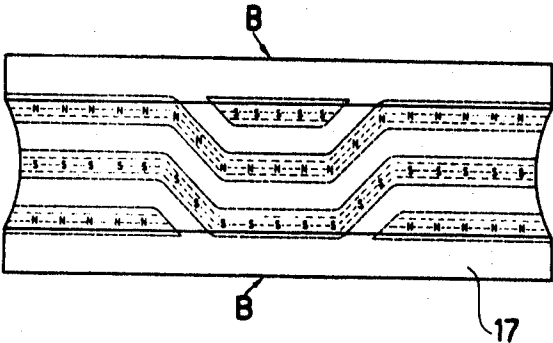


FIG. 9

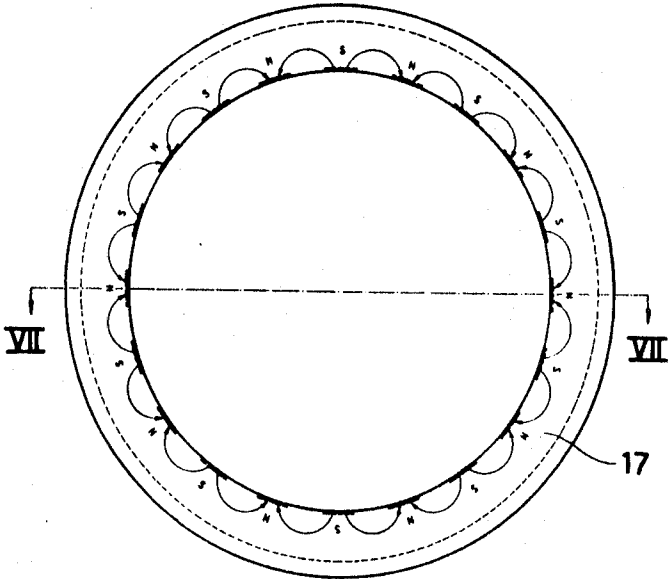
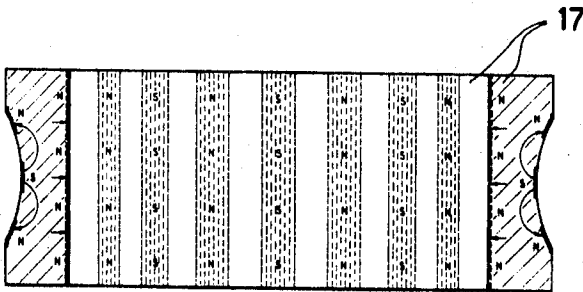


FIG. 7



MAGNETIC ROTARY SWITCH

This invention relates to a magnetic rotary switch and more particularly a snap acting magnetic rotary switch.

Rotary switches are known, comprising spring brushes rotating and contacting further rigid brushes after one another, causing the closure of contacts these brushes are part of; contact opening and closing is carried out at the feeding speed of the rotating brushes, this speed being always very low.

When desiring a fast opening and closing of the contacts, microswitches are resorted to, which are generally provided with so-called snap acting spring systems and operated by pushbuttons carrying out contact opening and closing at a high speed; such microswitches are also referred to as "snap" microswitches as the opening and closing speed is always high and independent of the feeding speed of the control pushbuttons. However, it is well known that a series of microswitches arranged about a cam provided with a shaft and mechanical snap action forms a complex, cumbersome and expensive construction.

Magnetic switches, referred to as "proximity switches," are also known and generally comprise a permanent magnet which, on approaching two iron-magnetic contacts, cause the opening or closing thereof; the contacts are usually arranged within a sealed box and the magnetic control is through a diamagnetic diaphragm. Known magnetic proximity switches are made as simple switches having a single movable contact.

An object of the present invention is to provide a snap acting magnetic rotary switch, fitted with a plurality of switches having contacts which can be opened or closed by snap action, or a speed independent of the speed of rotation for the switch.

Another object is to provide a snap acting magnetic rotary switch which is of a simple structure and construction, inexpensive and reduced size.

These and other objects are attained by a rotary magnetic switch comprising a plurality of switches circumferentially mounted on a rigid body and each having two fixed contacts and a movable contact therebetween, a permanent magnet fast with said movable contact and having a magnetized circular-shaped sector surface thereof with at least two poles aligned with said fixed contacts, a first annular permanent magnet fast with said rigid body and having as many pairs of laterally magnetized poles as the switches, and a shaft carrying a second rotary permanent magnet annularly shaped and interposed between said first permanent magnet and the permanent magnets fast with said movable contacts, this switch being characterized in that on its surface opposite the adjacent surface of the first permanent magnet said second permanent magnet has as many pole pairs of a lateral magnetization as the switches, the cross section of the surface of the second permanent magnet opposite the permanent magnets fast with said movable contacts is of a circular sector shape conjugated to the circular sector shape of the permanent magnets fast with the movable contacts and has at least three laterally magnetized poles substantially in the form of three rings, the intermediate ring of which is one pole and the two rings located sidewise thereto are the outer fractional pole, at least at a location one of the sidewise located ring-shaped poles being interrupted and the other ring-shaped poles being deformed to the interruption location of said pole forming a loop, including therein a laterally magnetized pole of opposite sign to that of the ring-shaped pole adjacent thereto.

In order that the structure and features of the snap acting magnetic rotary switch be more clearly understood, two embodiments thereof will now be described as given by mere way of not limiting example, reference being had to the accompanying drawings, in which:

FIG. 1 is an axial sectional view showing a first embodiment of the snap acting magnetic rotary switch;

FIG. 2 is a plan view showing the switch carrying portion of the switch in FIG. 1;

FIGS. 3, 4 and 5 are a cross-sectional view, and respectively views from either side of an annular permanent magnet forming part of the switch;

FIG. 6 is an axial sectional view showing a second embodiment of the snap acting magnetic rotary switch; and

FIGS. 7, 8 and 9 are, respectively, a cross-sectional view, a side view and a front view of a permanent magnet in the form of a cylindrical tubular body forming part of the switch in FIG. 6.

Firstly, reference is had to FIGS. 1—5, wherein a first embodiment of the snap acting magnetic rotary switch is shown. This switch has a rigid body 1 (FIGS. 1 and 2) carrying ten switches circumferentially arranged and each comprising an inner fixed contact 2, an outer fixed contact 3 and a contact 4 which is movable between contacts 2 and 3: in the embodiment shown in FIG. 1, the movable contact 4 is rockably mounted on a pin 5 and therewith a permanent magnet 6 is fast, the free surface of which is sector-shaped with its center on the axis of pin 5, the magnet 6 being two-pole magnetized, which poles are aligned with said fixed contacts 2 and 3 and all having the pole of one sign adjacent contact 2 and the pole of opposite sign adjacent contact 3.

In the switch a rigid body 7 (FIG. 1) is fast with the rigid body 1, having secured thereto a first permanent magnet 8 in the form of an annular disc, and more particularly a washer, the surface of which facing the switches has ten pairs of laterally magnetized poles, radially extending on the surface of magnet 8 in a completely similar manner as shown in FIG. 4 and as described below.

A rotary shaft 9 is mounted on body 7 and freely rotatable about its axis, a second permanent magnet 11 shaped as an annular disc, or more particularly as a washer, being fast with end of this shaft. FIGS. 3, 4 and 5 show said magnet 11 in cross-sectional view and plan views from either side. On its surface opposite the adjacent surface of magnet 8, this magnet 11 has ten pairs of laterally magnetized poles radially extending, as clearly shown in FIG. 4. As above outlined, these poles of magnet 11 are completely similar to those on magnet 8.

The surface of magnet 11 opposite magnets 6 fast with the movable contacts 4 is of a sector-shaped cross section conjugated to the sector shape of magnets 6, as clearly shown in FIG. 3 and particularly FIG. 1; three lateral magnetization poles are formed on said surface of magnet 11, substantially as three concentric rings of different diameters from one another (FIG. 5), the intermediate ring being one pole and the two rings sidewise located thereto being the other fractional pole. Still as shown in FIG. 5, at the location of magnet 11 designated by A, that pole of said ring-shaped poles which is sidewise located and of a smaller diameter than the other ring poles, is interrupted, whereas the other two ring-shaped poles are deformed to the interruption location of the other pole, providing a loop receiving a lateral magnetization pole of opposite sign to that of the ring-shaped pole adjacent thereto, as clearly shown in FIG. 5, at the location designated by A.

The radially arranged poles on the opposite surfaces of magnets 8 and 11 are effective to firmly hold at exactly determined steady position shaft 9 with magnet 11 relative to body 7 with magnet 8 relative to magnets 6. When rotated, shaft 9 will stop at one of ten different angular positions where location A of magnet 11 is positioned at one of said magnets 6.

As shown in the drawings, since magnets 6 of the movable contacts 4 are of opposite polarities to those of the ring-shaped poles on the adjacent surface of magnet 11, it ensues that magnets 6, except for that magnet located at location A of magnet 11, are attracted from one side, or are urged towards contacts 2, against which contacts 4 bear. Only that magnet 6, which is positioned at location A of magnet 11, is urged in a direction opposite that of the other magnets 6, or is outwardly urged, so that its movable contact 4 rests on contact 3 adjacent thereto.

During rotation of shaft 9, all but one of the contacts 4 fast with magnets 6 rest on contacts 2: as location A of the ring poles for magnet 11 approaches the subsequent contacts 4

resting on the subsequent contacts 2, these contacts 4 are increasingly forced onto the associated contacts 2 until, when the maximum pressure has been attained, the magnetic balance is inverted and magnets 6 with their contacts 4 are strongly urged to the other side, that is against the adjacent contacts 3, thus causing the contact to shift rapidly. It should be noted that the contact switching speed is independent of the speed of rotation of shaft 9 and magnet fast therewith.

Reference will be had now to FIGS. 6—9 relating to an embodiment of the rotary magnetic switch different from that above described.

The switch of FIG. 6 comprises a rigid body 12 carrying ten switches, each of which comprising an inner fixed contact 13, an outer fixed contact 14 and an intermediate movable contact 15 carrying a permanent magnet 16, with a structure completely similar to that as described in connection with FIG. 1.

The switch also comprises a permanent magnet 17, shaped as a cylindrical tubular body, as clearly shown in FIGS. 7, 8 and 9. The magnet 17, fast with two discs 18 and 19, respectively, rotating on a fixed shaft 20, is part of the rotor for a stepping motor provided with coils 21 and having a permanent magnet 22 forming a stator portion of the stepping motor. On its surface opposite the magnet 17, said magnet 22 has ten pairs of lateral magnetization poles and as many pairs of lateral magnetization poles are provided on the cylindrical inner surface of magnet 17, as shown in FIG. 7.

On its outer surface said magnet 17 has a slot of a sector-shaped cross section conjugated to the sector shape of magnets 16, as shown particularly in FIG. 6 and FIG. 8. At said slot, magnet 17 has three pairs of lateral magnetization poles, particularly shown in lateral 8, substantially in the form of three rings coaxial one another and of diameters substantially identical to one another; wherein the intermediate ring is one pole and two rings located sidewise hereto are the other fractional pole. Similarly as stated in connection with the above described construction for the switch, at location B one of the sidewise located ring-shaped poles is interrupted and the other two ring-shaped poles are deformed to the interruption location of the other pole, forming a loop or recess accommodating a lateral magnetization pole of opposite sign to that of the ring-shaped pole adjacent thereto. The operation of the switch is completely similar to that for the switch of FIGS. 1—5, since for each step feeding of the stepping motor, the location B of magnet 17 is subsequently positioned on a distinct magnet 16 which is snap shifted from a position where it rests on a contact 13 to a position where it rests on an adjacent contact 14. Still here the shift speed for the movable contact 15 from one fixed contact to the other fixed contact is independent of the

speed of rotation of rotor 17, that is the speed of rotation of the stepping motor. From the foregoing it will be readily seen that the construction of the rotary magnetic switch is simple, the operation of the switches is carried out merely through the action of a magnetic field not causing any mechanical wears and avoiding, therefore, any risk of wear breakages, and the capability of providing a very rapid operation of the individual switches which are firmly retained at a steady position by the magnetic field of the rotary magnet adjacent thereto.

What we claim is:

1. A rotary magnetic switch comprising a plurality of switches circumferentially mounted on a rigid body and each having two fixed contacts and a movable contact therebetween, a permanent magnet fast with said movable contact and having a magnetized sector-shaped surface thereof with at least two poles aligned with said fixed contacts, a first annular permanent magnet fast with said rigid body and having as many pairs of lateral magnetization poles as the switches, and a shaft carrying a second rotary permanent magnet annularly shaped and interposed between said first permanent magnet and the permanent magnets fast with said movable contacts, wherein on its surface opposite the adjacent surface of the first permanent magnet said second permanent magnet has as many pairs of lateral magnetization poles as the switches, the cross section of the surface of the second permanent magnet opposite the permanent magnets fast with said movable contacts is of a sector shape conjugated to the sector shape of the permanent magnets fast with the movable contacts and has at least three lateral magnetization poles substantially in the form of three rings, the intermediate ring of which is one pole and the two rings located sidewise thereto are the other fractional pole, at least at a location one of the sidewise located ring-shaped poles being interrupted and the other ring-shaped poles being deformed to the interruption location of said pole forming a recess accommodating a lateral magnetization pole of opposite sign to that of the ring-shaped pole adjacent thereto.

2. A rotary magnetic switch according to claim 1, wherein said first and second annularly shaped permanent magnets comprise discs parallel to one another wherein said pole pairs are radially arranged and said ring-shaped poles are concentric and of diameters different from one another.

3. A rotary magnetic switch according to claim 1, wherein said first magnetic switch forms a stator portion for a stepping motor, said second permanent magnet is a cylindrical tubular body forming part of the rotor for said stepping motor and said ring-shaped poles are coaxial and of diameters substantially identical to one another.

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