

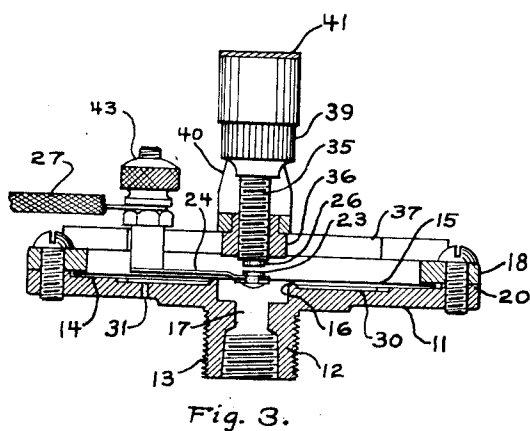
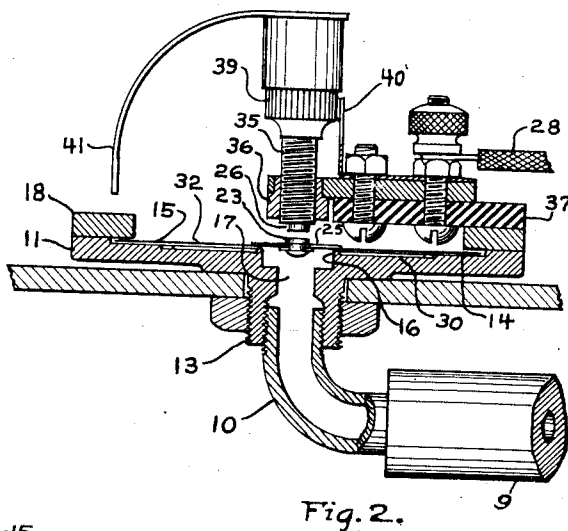
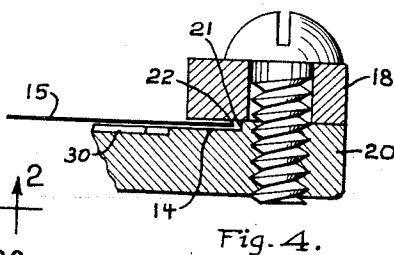
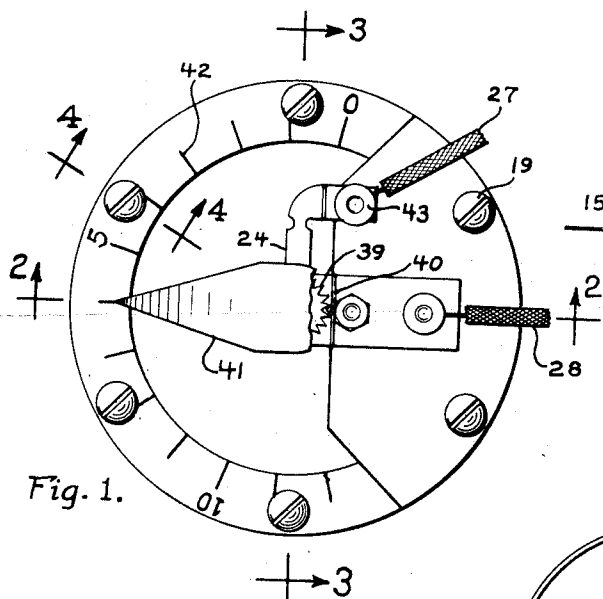
Nov. 14, 1944.

G. G. WILEY

2,362,874

DIAPHRAGM SWITCH

Original Filed Feb. 19, 1940



Inventor
George G. Wiley
By *Roland C. Lehan*
Attorney

UNITED STATES PATENT OFFICE

2,362,874

DIAPHRAGM SWITCH

George G. Wiley, Chicago, Ill., assignor to Streeter
Amet Company, Chicago, Ill.

Original application February 19, 1940, Serial No.
319,667. Divided and this application September 18, 1942, Serial No. 459,947

5 Claims. (Cl. 200—83)

This invention relates to switches for counting apparatus and the like used, for example, in counting vehicular traffic, and among other objects aims to provide an improved pneumatically operated switch for controlling the operation of the counter or other mechanism.

The nature of the invention may be readily understood by reference to one illustrative construction embodying the invention and shown in the accompanying drawing.

In said drawing:

Fig. 1 is a plan view of the switch device;

Fig. 2 is a cross-section thereof taken on the plane 2—2 of Fig. 1;

Fig. 3 is another cross-section taken on the plane 3—3 of Fig. 1; and

Fig. 4 is a fragmentary section on the plane 4—4 of Fig. 1 showing on an enlarged scale a detail of the switch structure.

Automatic counting of vehicular traffic presents problems not encountered in counting other things. For example, traffic counting apparatus, one example of which being illustrated in my co-pending application Serial 319,667, now Patent No. 2,340,634, patented February 1, 1944, of which this application is a division, is not under constant observation or attention; it is subject to a wide range of temperatures under all of which it must operate reliably; and the character of the traffic-created operating signals varies widely. Such variation occurs particularly if the apparatus respond to pneumatic impulses created by vehicles crossing a pneumatic tube or the like. Slowly moving traffic or traffic crossing the remote end of the detector tube, delivers a faint impulse. Heavy, wide or multiple tread vehicle tires and traffic crossing the detector tube close to the counter create strong impulses and also supplementary oscillations in the pneumatic system which are difficult to distinguish from traffic-created impulses. Rapidly traveling vehicles create impulses of very short duration whereas dense traffic characterized by vehicles traveling nearly abreast create impulses having exceedingly short intervals between them.

The illustrative device is designed to respond reliably to a wide variation in primary or traffic-created impulses and to differentiate these from secondary or supplementary oscillations in the pneumatic system. It will be understood, however, that the present switch device is not limited in its use to control any particular form of counting or other apparatus.

The traffic detector tube which may advantageously be in the form of flexible tube 9 (only

partly shown) of rubber or similar material stretched transversely across the highway, is connected at one end to a fitting 10 leading to the switch mechanism and by means of which the pneumatic impulses are conducted thereto. In the present case fitting 10 is screwed into a diaphragm housing 11 in the form of a circular and generally flat plate having a hollow threaded boss 12. The boss 12 advantageously serves not only as the means of connection with the road tube but as a means of mounting the switch in any desired position. For that purpose it is provided with exterior threads 13 on which a clamping nut or the like may be screwed. The opposite face of the housing is provided with an outer annular seat 14 for the margin of diaphragm 15 and an inner seat 16 around the inlet passage 17. The diaphragm is held against displacement by an annular ring 18 attached by screws 19 or other appropriate fastening means to the margin 20 of the housing beyond the outer edge of the diaphragm. The inner edge 21 of the margin of the diaphragm housing is spaced beyond the edge 22 of the diaphragm and is also substantially thicker than the diaphragm to provide clearance both beyond the edge of the diaphragm and between the diaphragm and the seat 14 and the ring 18. Thus while the diaphragm is held against substantial displacement it is otherwise free in the housing. In the present case the clearance around the diaphragm is about one sixty-fourth of an inch.

Controlled by the diaphragm is a movable contact point 23 in the form of a rivet which serves to attach the contact point to the diaphragm and to connect the flexible electric conductor 24 thereto. Between the head of the contact point and the diaphragm is a relatively stiff disc 25 also connected by means of the conductor rivet to the diaphragm, and whose function it is to prevent substantial local flexing of the diaphragm. Opposite the movable contact 23 is an adjustable stationary contact 26 insulated from the movable contact as presently described. Electric conduits 27 and 28 lead to the movable and stationary contacts respectively.

To enable the switch device to differentiate between faint traffic-created impulses and secondary pneumatic oscillations which produce only slightly fainter impulses, the contact gap between the stationary and movable contacts is carefully adjusted. This gap under normal operating conditions is quite small i. e., from .004 to .009 inch, much smaller than customary contact gaps for other traffic operated switches. With a gap of

this character faint traffic-created impulses are just sufficient to make contact, whereas the secondary oscillations are not quite strong enough to deflect the diaphragm sufficiently to close the gap. In ordinary switches the use of such a small gap would cause additional difficulty such as faulty operation due to distortion of the diaphragm and lack of uniform diaphragm deflection under impulses of a given strength. Diaphragm distortion has the effect of changing the effective contact gap and obviously distortion of as little as two or three thousandths of an inch might produce faulty operation. Both diaphragm distortion and temperature variation result in erratic or non-uniform deflection of the diaphragm.

Faulty operation of this character has been eliminated by the free mounting of the diaphragm as above described. This prevents stretching or distortion of the diaphragm under deflection by pneumatic impulses and by thermal expansion and contraction. Indeed with the free mounting and the clearances at the margin of the diaphragm, little actual diaphragm deflection is required. This avoids fatigue in the diaphragm. Strong pneumatic impulses are prevented from excessively deflecting the diaphragm by allowing such impulses to expand laterally below the diaphragm and to escape around the edges of the diaphragm. For this purpose the housing is undercut or recessed as at 30. Weak impulses on the other hand are not duly dissipated since they are initially confined against lateral expansion by the annular seat 16 adjacent the inlet passage 17. Lateral expansion or dissipation of the impulse cannot occur until the diaphragm has been raised beyond the annular seat 16 after which lateral expansion is not serious since the diaphragm and contact have been given sufficient momentum to complete closing of the contacts.

The annular seat 16 closely adjacent the inlet passage 17 also advantageously prevents deflection of the diaphragm away from the stationary contact under periodic suction following an impulse and created by oscillation of the air column in the pneumatic system. This avoids oscillation of the diaphragm in response to oscillation of the air column and avoids any failure to close the contacts under a faint impulse such as would be the case if the contacts were permitted to separate (under reverse deflection of the diaphragm) beyond a predetermined maximum. In the present case the predetermined maximum contact gap (fixed by adjustment of the contact 26) cannot be exceeded since outward or reverse deflection is prevented by the annular seat 16.

Additional venting or escape for strong impulses may be provided if necessary by one or more passages 31 in the diaphragm housing itself and located beyond the annular seat 16. Also for the same purpose if desired one or more small openings 32 may be formed in the diaphragm itself at a point beyond the seat 16. Openings such as 31 and 32 may be very small such as formed by a No. 60 drill.

Excessively strong impulses are thus partly dissipated without a corresponding effect on weak impulses and without damage to the diaphragm; and ensuing secondary oscillations are minimized or damped to intensities below that of the minimum traffic-created impulses. The close control of the contact gap as aforesaid makes it possible to eliminate the effect of false signals from secondary oscillations without making the device insensitive to the only slightly stronger traffic-

created impulses. The diaphragm is also protected from distortion and erratic deflection which would nullify the selective operation made possible by close contact gap adjustment.

The diaphragm is advantageously made of vinyl resin (which may be obtained on the market under the trade name Vinylite) or other appropriate material whose deflection characteristics are not substantially affected by variation in temperature as is the case with diaphragms made of rubber and similar materials. The thickness of the diaphragm may advantageously be about .005 inch. In the present instance the stationary contact is made adjustable by forming it with a screw-threaded shaft 35 threaded through a nut 36 mounted on a piece of electric insulation 37 which in turn is attached by one or more of the screws 19 to the diaphragm housing. The threaded shaft carries a fluted head 39 against which bears a spring 40 which serves both to hold the contact in adjusted position and as a conductor for making an electrical connection between wire 27 and the contact. For that purpose the shaft 35 and its head 39 are made of metal. The contact shaft is also advantageously provided with a pointer or index 41 which in conjunction with the scale 42 formed on the ring 18 indicates the contact gap in thousandths of an inch. Zero contact gap may then be accurately fixed with reference to the scale 42.

The flexible conductor 24 for the movable contact is also mounted on and connected to the insulator 37 by means of a terminal 43 to which the wire 28 is connected. Wires 27 and 28 are appropriately connected in the circuit to be controlled by the diaphragm switch.

Obviously the invention is not limited to the details of the illustrative device since these may be variously modified. Moreover, it is not indispensable that all features be used conjointly since various features may be used to advantage in different combinations and subcombinations.

Having described my invention, I claim:

1. In a high speed counter a switch device responsive to short pneumatic impulses of varying intensity comprising in combination a housing, a substantially flat diaphragm in said housing of such light weight as to be moved by faint impulses, a passage in said housing to direct said impulses against said diaphragm, stationary and movable electrical contacts having a small contact gap between 0.004 and 0.009 of an inch, the movable contact being moved by said diaphragm, said stationary contact being adjustable toward and away from said movable contact, a support in said housing to prevent deflection of said diaphragm away from said stationary contact, said housing having a seat for loosely holding said diaphragm and leaving the margins thereof free so as not to cause permanent distortion of said diaphragm, thereby making it possible to maintain a uniform but small contact gap.

2. In a high speed switch the combination comprising, a diaphragm case, a thin diaphragm seated in said case, means for directing air impulses against said diaphragm, an electrical contact member spaced from said diaphragm, another contact on said diaphragm adapted upon a predetermined deflection of said diaphragm to engage the first named contact, and means for adjusting said first named contact to a predetermined spacing from said other contact to prevent closing of the circuit upon minor movements of said diaphragm, said case being provided with means for loosely holding the margins

of said diaphragm to prevent distortion thereof which would interfere with the effective spacing between said contact and said diaphragm.

3. In vehicle counting apparatus responsive to air impulses of varying intensity, the combination comprising a switch having a relatively flat diaphragm moved by said impulses, a housing for said diaphragm having a passage for conducting the impulses thereto, said housing having a seat for engaging said diaphragm marginally and designed to permit leakage of strong impulses around said diaphragm thereby to minimize diaphragm distortion, said housing providing a support for said diaphragm and having below said diaphragm a space adapted to be connected with said passage to permit lateral expansion of strong impulses, thereby to reduce the strength of secondary oscillations in said tube.

4. In vehicle counting apparatus responsive to pneumatic impulses of varying intensity, the combination comprising a diaphragm housing, a flexible diaphragm in said housing, a passage in said housing adapted to direct pneumatic impulses toward said diaphragm in close proximity

to the center thereof, said housing loosely engaging the margins of said diaphragm so as to prevent permanent distortion thereof, and means including a rigid disc rigidly connected to said diaphragm opposite said passage to limit flexure of the center of the diaphragm under the impact of said pneumatic impulses.

5. In counting apparatus responsive to pneumatic impulses, the combination comprising a diaphragm housing having therein a passage for air impulses, a flexible relatively flat diaphragm in said housing adapted to be moved by said air impulses and lying transversely to the direction of said impulses and being bodily displaced by said impulses, a pair of normally open electrical contact members adapted to be closed by predetermined deflection of said diaphragm and having such small gap as substantially to affect the amount of deflection necessary to close said contacts if the diaphragm be permanently distorted, said housing loosely engaging the margins of said diaphragm so as to prevent permanent distortion thereof.

GEORGE G. WILEY.