

March 6, 1956

J. W. WELSH

2,737,553

SNAP-ACTION VANE

Filed April 8, 1955

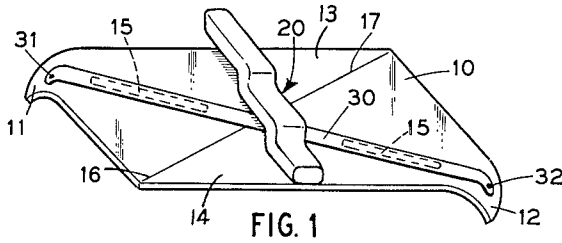


FIG. 1

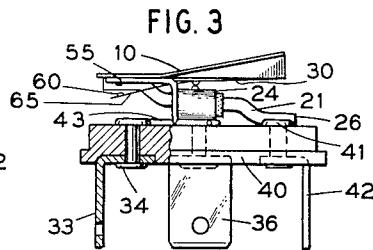


FIG. 3

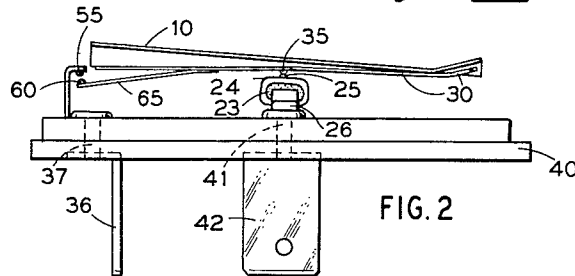


FIG. 2

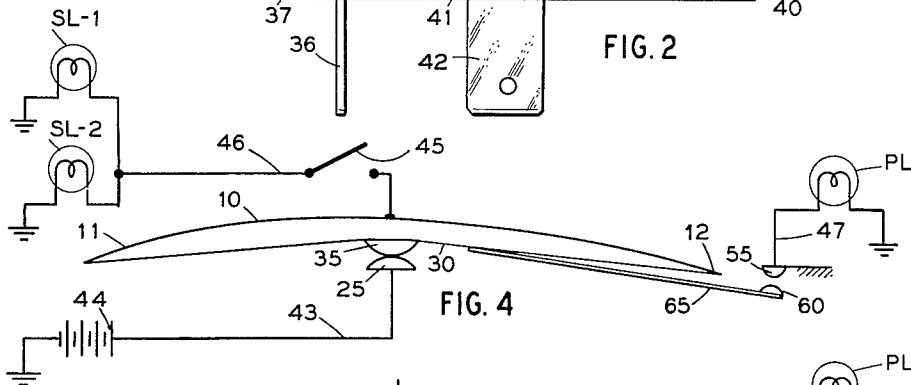


FIG. 4

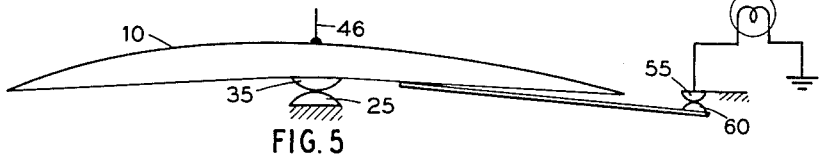


FIG. 5

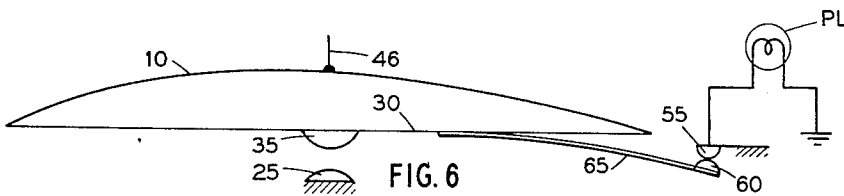


FIG. 6

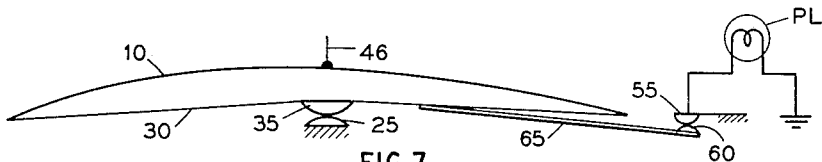


FIG. 7

INVENTOR.
James W. Welsh
BY
Daymon
ATTORNEY

1

2,737,553

SNAP-ACTION VANE

James William Welsh, Summit, N. J., assignor to Signal-Stat Corporation, Brooklyn, N. Y., a corporation of New York

Application April 8, 1955, Serial No. 500,087

6 Claims. (Cl. 200—122)

This invention relates to snap action electric switches and, more particularly, to a snap action flasher embodying a novel pilot lamp contact arrangement.

This application is a continuation in part of my copending application Ser. No. 374,977, filed August 18, 1953, now Patent No. 2,706,226, for "Snap-Action Vane."

The usual flasher includes a high resistance wire or strip which, when current flows therethrough, heats rapidly and expands. The wire is operatively associated with a movable switch arm to hold this arm against a first contact when the wire is cold and thus contracted. As the wire expands, the arm is spring biased to disengage such first contact and break the heating circuit for the wire. The latter thereupon cools and contracts to reengage the arm with such first contact and thus re-close the heating circuit for the high resistance wire to repeat the operating cycle. In some flashers, when the high resistance wire expands to disengage the arm from the first contact, the arm engages a second contact which may control another circuit.

To operate the pilot lamp, a magnetic switch or relay is associated with either one of the two contacts, dependent upon whether synchronous or alternate operation of the pilot lamp is desired. This relay, when energized, closes a circuit for the pilot lamp. The flasher parameters are generally so selected that, if a signal lamp is inoperative, the current load is insufficient to operate the relay and the pilot lamp is not energized. This apprises the vehicle operator of lamp trouble in the signal circuit.

The present flasher arrangements, including pilot lamp relays, while reliable in operation, are relatively complicated and frequently too expensive for many installations. Hence, there is a demand for a simple, reliable and inexpensive flasher pilot lamp device.

In my copending application, Ser. No. 374,976, filed August 18, 1953, for "Snap Action Device," I have shown and described a novel snap action vane which may be incorporated in a snap action switch. This vane is provided with an initial deformation along a right line extending across the vane by thinning or deforming the vane along this line in two or more spaced sections of the line, these sections being spaced at their inner ends from the center of the vane and also preferably spaced from the outer ends of the bent line. When such a vane is to be utilized in a snap action switch, such as a flasher, the vane is bent about another line, at an angle to the line of initial deformation by applying force to the ends of such line. When such force is released, the vane snaps back to its initial position, the action closely resembling that of a toggle.

The vane is held in the new deformed position by attaching a high resistance wire or strip at each of its ends to the vane at the ends of the line of initial deformation. This high resistance wire or strip thus forcibly holds the vane in a distorted position bent about a line angularly related to the line of initial deformation. When the high resistance wire has electric current passing therethrough, it heats and expands. During the expansion of the wire, a point is reached at which the tension exerted by the wire

2

is over-balanced by the kinetic energy of the vane stored therein by bending the latter from its initial bent condition. At this point, the vane snaps back to its initial condition.

As described in said copending application, Ser. No. 374,976, the vane has a mounting member secured thereto at a point in an elliptical line representing the distribution of stresses adjacent the vane center due to the initial deformation of the vane. This mounting member extends across the high resistance wire and carries a contact co-operative with a contact carried by the high resistance wire. When the vane is in the deformed position, in which it is held by the contracted high resistance wire, these two contacts are in engagement, so that current from a source of electric power connected to a contact carried by the mounting member flows in parallel paths through the high resistance wire, through the vane, and thence to the other terminal of the current source. When the vane snaps back to its initial condition as a result of heating and expansion of the wire, the contacts separate and the high resistance wire then cools and contracts. During such contraction, the force exerted by the wire over-balances the force tending to maintain the vane in its initially deformed condition, and the resultant toggle action snaps the vane to the deformed condition re-engaging the contact carried by the resistance wire with the contact carried by the mounting member for the vane. The electrical circuit is thus reclosed and the cycle repeats.

In the arrangement described in my said copending application Ser. No. 374,977, a contact is secured to one of such vane corners for movement therewith. This contact is operatively associated with a second contact fixed relative to the vane mounting member or bracket. As the vane snaps between its deformed and restored positions, when the flasher is connected to a source of electric potential, these last mentioned contacts are alternately engaged and disengaged. The pilot lamp is connected to the relatively fixed contact. The vane-carried contact is made "live" by virtue of the circuit connection to the vane through its mounting member. Thus, the pilot lamp of such arrangement is flashed whenever the flasher is energized. Preferably, the pilot lamp contacts are engaged when the vane is in the restored position and disengaged whenever the vane is snapped to the deformed position by cooling contraction of the resistance wire, so that the pilot lamp flashes in synchronism with the signal lamps. However, a reverse interaction of the contacts may be equally well provided to obtain alternation of the pilot lamp and signal lamp flashing.

Due to the division of the current in two parallel paths through the resistance wire, in the event a signal lamp is inoperative the resultant reduced current flow will be insufficient to heat the wire sufficiently to expand to the degree allowing snapping of the vane to the restored position. Thus, either steady burning or non-illumination of the pilot lamp will indicate a defective signal lamp.

While this arrangement works very well in practice, I have found that the same good operative results may be achieved by securing the movable pilot lamp contact to the free end of an elongated spring arm welded or otherwise secured at or near the mid point of the pull wire or ribbon.

In the cold or fully contracted condition of the ribbon, the latter forms an inverted V due to the pressure of the two main contacts. In this condition of the ribbon, the spring arm extends at such an angle that the pilot lamp contacts are separated. When the flasher circuit is closed, the ribbon heats and expands and its V becomes shallower. This changes the angle of the spring arm to engage the pilot lamp contacts. As the ribbon heats further and tends to flatten, the spring arm bends, maintaining the pilot lamp contacts engaged under increasing pressure.

The main contacts now snap open and the ribbon cools

and contracts to re-engage the main contacts. However, the auxiliary or pilot lamp contacts remain closed since the main contacts are engaged before the ribbon has fully cooled and thus before the ribbon has resumed its initial completely cold condition in which latter condition the angle of the V is such that the auxiliary contacts are separated.

For an understanding of the invention principles, reference is made to the following description of a typical embodiment thereof as illustrated in the accompanying drawings.

In the drawings:

Fig. 1 is a perspective view of a snap action vane and mounting member used in the invention flasher;

Fig. 2 is an elevation view, partly in section of the invention flasher;

Fig. 3 is an elevation view of the flasher at right angles to the view of Fig. 2; and

Figs. 4 through 7 are diagrams illustrating operating positions of the flasher.

Referring to Fig. 1, which is substantially identical with Fig. 1 of my said copending application, Serial No. 374,977, a snap action vane 10 is illustrated which is identical with that shown and described in said copending application. Vane 10 is preferably made of relatively thin spring metal, with consideration being given to its spring factor, stiffness, temperature coefficient, and the like, in accordance with the desired rate of operation of the snap action.

To provide an initial set to vane 10 and to give the same some depth so that it will resemble a beam in its action, the vane 10, which is shown as a substantially rectangular vane, is deformed or thinned along diagonal interconnecting corners 11 and 12. This vane deformation is preferably effected by lineally embossing the vane along the line 11—12 in two elongated spaced portions or bosses 15. It will be noted that the bosses 15 have their inner ends disposed substantially equal distances from the center of vane 10 so that the center area of the vane is left unmarred. As explained in said copending application Serial No. 374,976, this greatly prolongs the life of vane 10 by removing the stress concentration from the center to a pair of points on bosses 15. If the deformation lines 11—12 were continuous through the vane center area, the flattening of the vane at the center during repeated cycles would eventually cause fatigue of the vane at the center and reduce the amount of force required to snap the vane between the illustrated position and another deformed position. Due to the bosses 15, sections 13 and 14 of the vane on either side of line 11—12 bend upwardly so that the vane assumes the form of a shallow V having its apex on line 11—12. When vane bending forces are applied to the end of lines 11—12, and the value of these forces equals or overbalances the inherent tendency of the vane to stay in its preset condition, the vane snaps into a new bent or deformed position, forming another shallow V along the other diagonal 16—17. When the forces at points 11 and 12 are decreased to a point where they are overbalanced by the kinetic energy stored in vane 10 due to such distorting force, the vane snaps back to a position bent along the lines 11—12.

Photographs, taken with polarized light, of a transparent vane formed in this manner show lines of force in the unmarred center area of the vane which comprise elliptical bands having radii centered on the vane center. If the vane is secured or supported at a point on one of these elliptical stress loci, the stress points on the vane during application of bending force at corners 11 and 12 occur within the lengths of bosses 15. Thus, the stresses are removed from the center area and distributed between two points spaced from the center. This greatly prolongs the period before fatigue takes place in the stressed section of the vane. As described in said copending application Serial No. 374,976, advantage is taken of this fact by

supporting the vane by electrically and mechanically securing the latter, at a point of one of such elliptical lines of force, to a relatively rigid electrically conductive metal mounting member 20. The point of attachment of the mounting member to the vane acts as a pivot point for the vane during its snap action and is preferably spaced laterally of the initial bend line 11—12.

When the vane is used to form a snap action switch, the bending stresses may be conveniently applied to points 11 and 12 by means of a high resistance wire or ribbon 30 secured to these corners of the vane. For this purpose, the points 11 and 12 are bent downwardly as illustrated in Fig. 1, and the ends of ribbon 30 are secured thereto at 31 and 32, while the vane is bent along the line 16—17, so that the ribbon in its cold or contracted position holds the vane deformed into a V having its apex along line 16—17. If ribbon 30 has electric current passed therethrough, it expands and, as the ribbon force is overbalanced by the restoring kinetic energy built up in vane 10, the vane snaps back to its initially bent condition along the line 11—12.

An arrangement for utilizing this action is illustrated in Figs. 2 and 3, which show the invention snap action switch. The center section 21 of mounting member 20 has a band 23 of insulation wrapped thereon and a band 24 of conductive metal is wrapped around band 23. Band 24 carries a contact point 25 at the intersection of mounting member 20 and ribbon 30. The ribbon 30 has a contact point 35 secured to its mid-section for cooperation with contact 25.

The free end of mounting member 20 is secured to a dielectric base 40 as by a rivet connecting the outer end 26 of member 20 to a prong or terminal 42 on base 40. Another prong or terminal 33 is connected by rivet 34 to a conductive strip 43 connected to band 24.

In accordance with the invention, base 40 has a third terminal or prong 36 secured by rivet 37 to a stepped contact 55 secured to base 40 adjacent a corner 11 or 12 of vane 10. Contact 55 is thus fixed relative to base 40 and bracket 20. Cooperable with fixed contact 55 is a movable contact 60 on the free end of a conductive metal spring arm 65 having its fixed end welded or otherwise secured near the midpoint of ribbon 30. Arm 65 preferably extends substantially parallel to ribbon 30 and diverges angularly therefrom so that, in the stress-deformed position of vane 10 illustrated in Figs. 1—4, contact 60 is separated from contact 55.

Referring to Fig. 4, a grounded battery 44 is connected to terminal 33, and thus through conductor 43 to band 24 and contact 25. A conductor 46 incorporating a signal lamp control switch 45, connects terminal 42, and thus vane 10 and bracket 20, to parallel and grounded signal lamps SL-1 and SL-2. A conductor 47 connects terminal 36, and thus relatively fixed contact 55, to grounded pilot lamp PL.

Referring more particularly to Figs. 2 and 4, the switch parameters are so selected that, in the fully contracted or cooled condition of ribbon 30, contacts 25 and 35 are engaged and the relation of parts is such that the center part of ribbon 30, carrying contact 35, is forced inwardly toward vane 10. The wire thus assumes a shallow V as is shown in Fig. 2, and the tension of ribbon 30 thus increases the force with which contacts 25 and 35 are held engaged. Contacts 55 and 60 are separated due to the V of ribbon 30 and the angle of arm 65.

When switch 45 is closed, current flows from battery 44 through conductor 43, band 24 and contact point 25 into contact point 35 at the midpoint of ribbon 30. At this midpoint, the current branches through both halves of ribbon 30, in parallel, and flows into vane 10 at points 31 and 32. The current flows through vane 10 into mounting member or bracket 20, and thus through rivet 41 into prong 42 and through conductor 46, switch 45 and parallel signal lamps SL-1 and SL-2 to ground. The current flowing through ribbon 30 causes the latter to

5

rapidly heat and expand, this ribbon preferably being "Nichrome" wire. As ribbon 30 expands and thus lengthens, the force exerted by the ribbon is finally overbalanced by the kinetic energy stored in vane 10, and the latter snaps to its initial or "restored" position. This pulls ribbon 30 downwardly relatively to bracket 20, and snaps contacts 25 and 35 apart to break the electrical circuit. The ribbon 30 then cools and contracts. As the force exerted by the contracting ribbon overbalances the force tending to maintain vane 10 in its "restored" position, the vane again snaps to a position bent along line 16-17 wherein ribbon 30 snaps toward bracket 20 to re-engage contacts 25 and 35. The cycle then repeats.

The initial relation of parts is shown diagrammatically in Fig. 4, which corresponds to the position of the switch or flasher shown in Fig. 2. It should be noted that the connection of battery 44 to prong or terminal 33 is exemplary only, and that the connections of terminals 33 and 42 could be reversed with battery 33 connected to terminal 42 and lamps SL-1, SL-2, to terminal 33. This reversal will result in a slightly different operation of pilot lamp PL as will be explained in connection with Fig. 7. With the parts as shown in Fig. 4 and with switch 45 closed, lamps SL-1 and SL-2 have a potential applied thereacross. Due to the bending of vane 10 about the line 16-17, ribbon 30 is initially at such position that contacts 55 and 60 are disengaged so that pilot lamp PL is not lit. Ribbon 30 is heating and expanding, and thus is moving upwardly to form a shallower V.

Should only one signal lamp SL-1 or SL-2 be operative, the current through ribbon 30 will be insufficient to heat and expand the ribbon an amount sufficient for the stored energy in vane 10 to snap the vane to its restored position. By proper initial spacing of contacts 55 and 60, these contacts will remain out of engagement during such partial heating of ribbon 30 and the resultant partial movement of vane 10 toward the restored position. Continued failure of pilot lamp PL to light indicates a defective condition of the signal lamp circuit.

However, if both signal lamps are operative, ribbon 30 continues to expand and vane 10 continues to flatten, thus increasing the angle of ribbon 30 sufficiently to move spring arm 65 upwardly to engage contacts 55, 60 to energize pilot lamp PL. This position is shown in Fig. 5.

As the ribbon 30 continues to heat and expand, the energy of vane 10 overbalances the stress imposed by ribbon 30 and the vane snaps to the restored position. This separates contacts 25 and 35 to open the signal lamp and wire 30 heating circuit. Contacts, 55, 60 however, remain engaged, due to the further flattening of ribbon 30, lamp PL being however de-energized due to opening of main contacts 25, 35.

With contacts 25, 35 separate, ribbon 30 starts to cool and contract, and, when the ribbon becomes sufficiently cool, vane 10 is snapped to the position of Fig. 7 to re-engage contacts 25, 35 resulting in flow of current through strip 30. The ribbon thus expands again to repeat the cycle.

It will be noted that contacts 55, 60 remain engaged even though ribbon 30 has cooled sufficiently to re-engage the main contacts 25, 35. This is due to the "residual heat" in ribbon 30, as the contraction of the strip is sufficient to re-engage contacts 25, 35 before strip 30 has fully cooled all the way to ambient temperature. Thus, contacts 55, 60, when once engaged as in Fig. 5, remain engaged as long as switch 45 is closed. When the switch 45 is opened, the ribbon 30 cools to ambient temperature and the parts assume the position of Fig. 4.

The invention thus takes advantage of the snap action movement of the vane 10 to provide a record and simplified pilot lamp energizing arrangement for flashers. This arrangement fulfils all the usual requirements for pilot lamp operations, including the circuit defect indicating functions, in an inexpensive and simple construction.

In addition, this invention provides for a circuit break-

6

ing effect in the event that a short should develop in the load lamps SL-1 and SL-2 or in the pilot lamp PL; in the event of the development of a short, the ribbon 30 becomes rapidly heated, expands and thereby "breaks" the main circuit formed through contacts 25-30; upon cooling, ribbon contracts and "makes" the main circuit through the aforesaid contacts; in effect, the flashing cycle is maintained albeit, the same is irregular as to "on" and "off" times; however, the advantage is present, that the flasher unit and the associated circuit elements are not burned out.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the invention principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A snap action electric switch comprising, in combination, a dielectric base; a substantially flat vane of electrically conductive resilient material having a substantially linear preset deformation extending thereacross, said deformation being interrupted intermediate its ends at points substantially equidistant from the vane center to leave the central area of the vane free of preset deformation; a first terminal on said base; an electrically conductive bracket secured at one end to said vane at a vane mounting point spaced laterally from said deformation, and secured at its other end to said first terminal; and expansible high resistance electric conductor secured at each end to said vane adjacent the outer ends of said deformation under tension and parallel to said deformation, to bend said vane to a stress-deformed position in which the vane is bent along a line substantially perpendicular to said deformation; said vane, upon a predetermined expansion of said conductor, snapping to a preset restored position in which the vane is bent along said deformation; said conductor changing position relative to said base during snapping of said vane; a first contact carried by said conductor; a second contact carried by said bracket in insulated relation and engaged by said first contact in the stress-deformed position of said vane; a second terminal on said base connected to said second contact; a third contact carried by said conductor; a third terminal on said base; a fourth contact secured to said third terminal for engagement by said third contact upon heating of said conductor; and means, including said first and second terminals, operable to alternately connect and disconnect a source of potential to and from said conductor to expand and contract the latter to snap the vane between such two vane positions.

2. A switch as claimed in claim 1 in which said third contact is carried by the free end of an electrically conductive spring arm secured to said conductor.

3. A switch as claimed in claim 2 in which said spring arms extends in the same general direction as said conductor.

4. A snap action electric switch comprising, in combination, a dielectric base; a substantially flat vane of electrically conductive resilient material having a substantially linear preset deformation extending thereacross, said deformation being interrupted intermediate its ends at points substantially equidistant from the vane center to leave the central area of the vane free of preset deformation; a first terminal on said base; an electrically conductive bracket secured at one end to said vane at a vane mounting point spaced laterally from said deformation, and secured at its other end to said first terminal; an expansible high resistance electric conductor secured at each end to said vane adjacent the outer ends of said deformation under tension and parallel to said deformation, to bend said vane to a stress-deformed position in which the vane is bent along a line substantially perpendicular to said deformation; said vane, upon a predetermined expansion of said conduc-

7

tor, snapping to a preset restored position in which the vane is bent along said deformation; said conductor changing position relative to said base during snapping of said vane; a first contact carried by said conductor; a second contact carried by said bracket in insulated relation and engaged by said first contact in the stress-deformed position of said vane; a second terminal on said base connected to said second contact; a third contact carried by said conductor; a third terminal on said base; a fourth contact secured to said third terminal for engagement by said third contact upon heating of said conductor; said bracket extending across the central area of said vane outwardly of said conductor; said first and second contacts being disengaged upon snapping of said vane to the restored position; and a source of potential connected across said first and second terminals.

5. A snap action electric switch comprising, in combination, a dielectric base; a substantially flat vane of electrically conductive resilient material having a substantially linear preset deformation extending thereacross, said deformation being interrupted intermediate its ends at points substantially equidistant from the vane center to leave the central area of the vane free of preset deformation; a first terminal on said base; an electrically conductive bracket secured at one end to said vane at a vane mounting point spaced laterally from said deformation, and secured at its other end to said first terminal; an expansible high resistance electric conductor secured at each end to said vane adjacent the outer ends of said deformation under tension and parallel to said deformation, to bend said vane to a stress-

8

deformed position in which the vane is bent along a line substantially perpendicular to said deformation; said vane, upon a predetermined expansion of said conductor, snapping to a preset restored position in which the vane is bent along said deformation; said conductor changing position relative to said base during snapping of said vane; a first contact carried by said conductor; a second contact carried by said bracket in insulated relation and engaged by said first contact in the stress-deformed position of said vane; a second terminal on said base connected to said second contact; a third contact carried by said conductor; a third terminal on said base; a fourth contact secured to said third terminal for engagement by said third contact upon heating of said conductor; said bracket extending across the central area of said vane outwardly of said conductor; said first and second contacts being disengaged upon snapping of said vane to the restored position; a grounded source of potential connected to said first terminal by a control switch; and a pair of grounded loads connected to said second and third terminals respectively.

6. A switch as claimed in claim 5 in which said third and fourth contacts are engaged before the conductor has expanded sufficiently to snap said vane to the restored position and remain engaged thereafter until said control switch is opened.

References Cited in the file of this patent

UNITED STATES PATENTS

2,615,106 Schmidinger ----- Oct. 21, 1952