Dec. 15, 1959 W. H. BUDD ET AL 2,917,720

HERMETICALLY SEALED VARIABLE RESISTOR

Filed Jan. 16, 1958 2 Sheets-Sheet 1

Fig. 1.

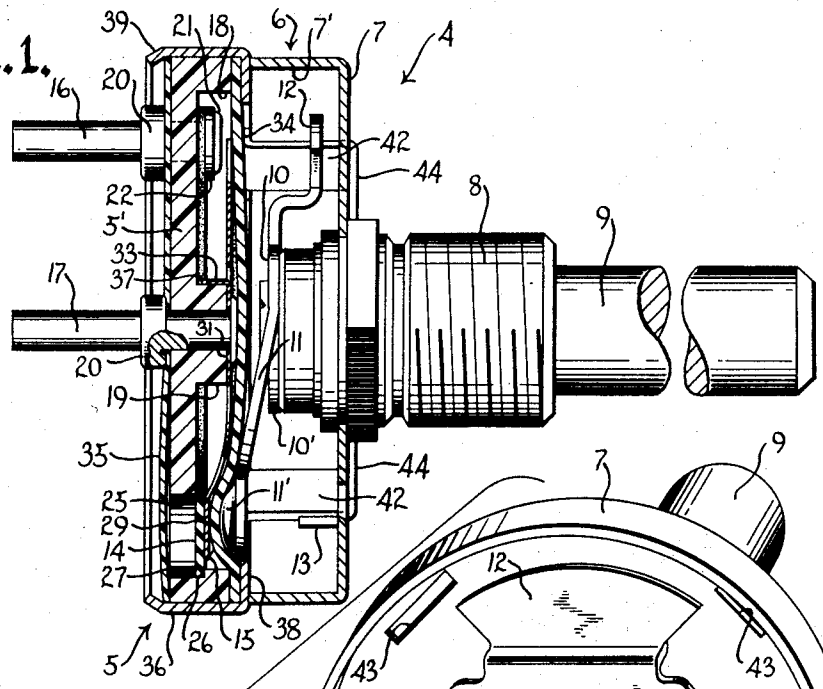
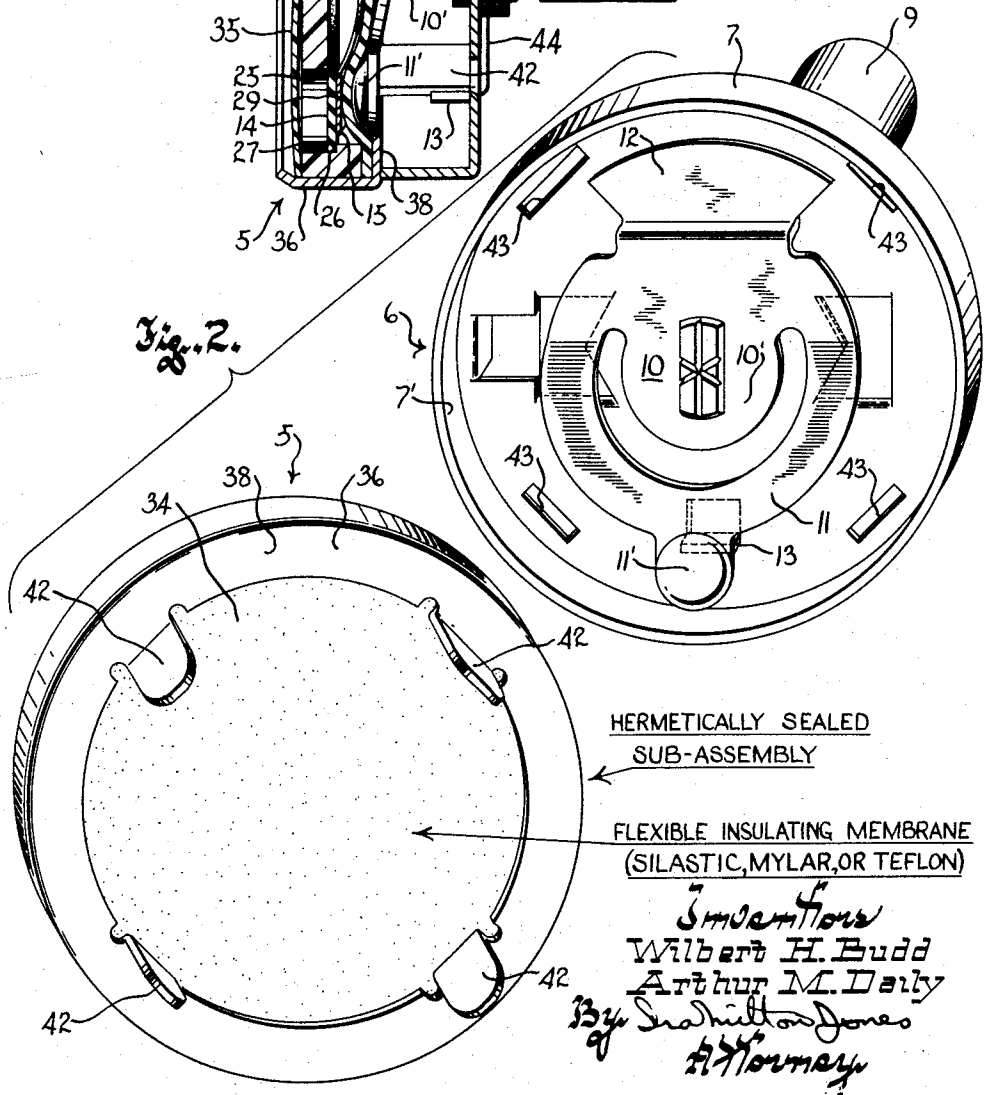


Fig. 2.



HERMETICALLY SEALED SUB-ASSEMBLY

FLEXIBLE INSULATING MEMBRANE (SILASTIC, MYLAR, OR TEFLON)

Inventors
Wilbert H. Budd
Arthur M. Daily
By Southworth & Jones
Attorneys

Dec. 15, 1959 W. H. BUDD ET AL 2,917,720

HERMETICALLY SEALED VARIABLE RESISTOR

Filed Jan. 16, 1958 2 Sheets-Sheet 2

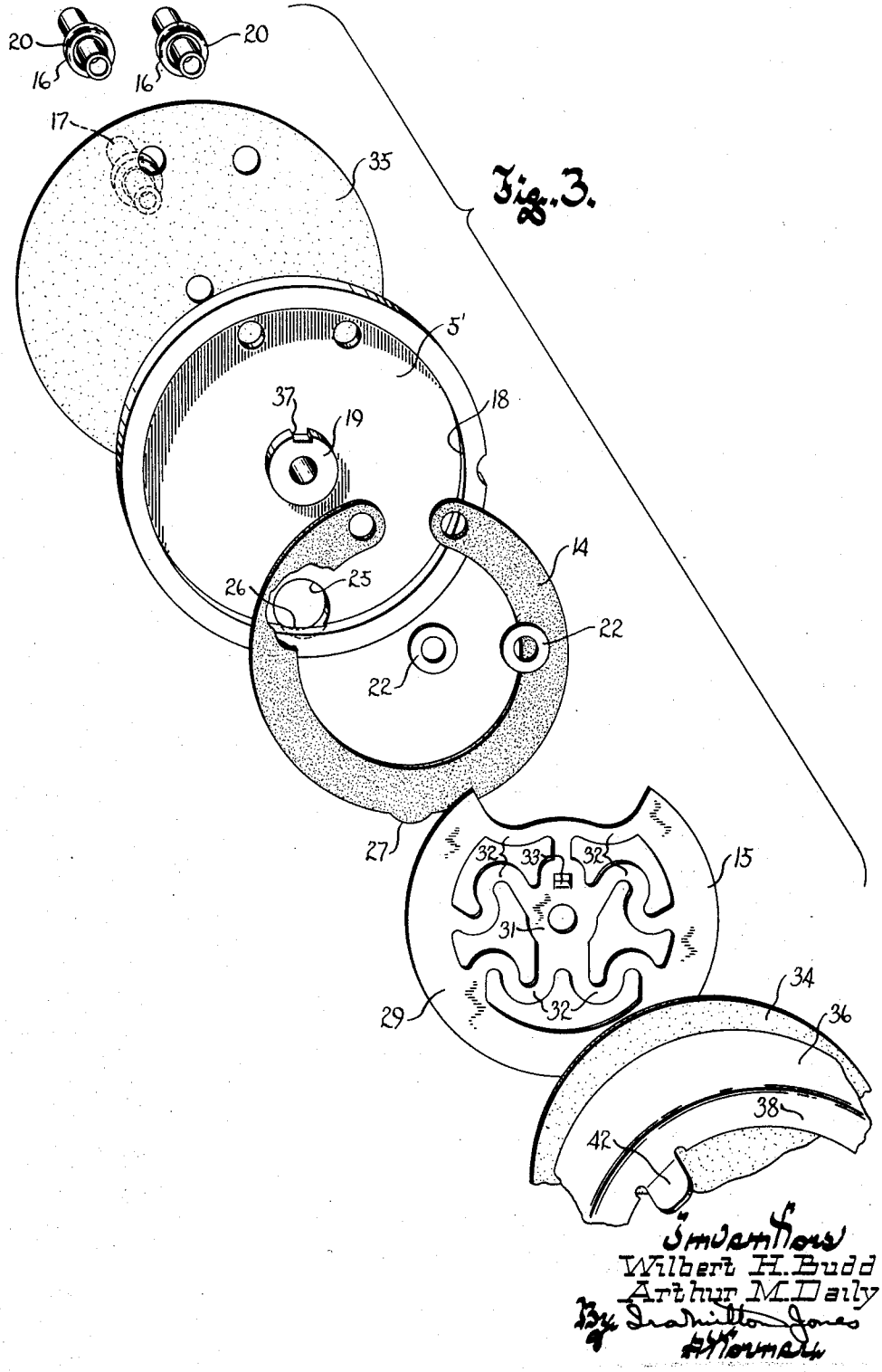


Fig. 3.

Inventors
Wilbert H. Budd
Arthur M. Daily
By Bradbury Jones
Attorneys

United States Patent Office 2,917,720
Patented Dec. 15, 1959

2,917,720

HERMETICALLY SEALED VARIABLE RESISTOR

Wilbert H. Budd, Elkhart, Ind., and Arthur M. Daily, Edwardsburg, Mich., assignors to Chicago Telephone Supply Corporation, Elkhart, Ind., a corporation of Indiana

Application January 16, 1958, Serial No. 709,218

7 Claims. (Cl. 338—154)

This invention relates to variable resistors and refers more particularly to a variable resistor having its resistance and contactor elements housed in an impermeable enclosure by which they are protected from corrosive and deleterious fumes and other foreign matter.

Variable resistors which are required to function in an atmosphere where certain types of fumes are present must have their resistance elements and contactors enclosed in a suitable housing or envelope that is impervious to such fumes. However, the mere provision of a hermetically sealed enclosure is usually insufficient to protect the resistor under all adverse circumstances, since the presence of deleterious fumes in the atmosphere is not the only condition which is detrimental to a variable resistor. The lubricant normally used in variable resistors to minimize rubbing friction between the collector ring and the contactor fingers or paddles which ride thereon, vaporizes at the elevated temperature conditions under which these controls are often operated and releases fumes which affect the stability of the resistor and are otherwise harmful to the resistance element. Hence the mere provision of an impermeable enclosure would merely confine such fumes in contact with the resistance element, producing results as harmful as if there were no enclosure at all.

It is therefore a general object of this invention to provide a variable resistor having its contactor and resistance element enclosed in an impermeable envelope, so that those elements are protected from any deleterious fumes which may be present in the surrounding atmosphere, and wherein the connection between the contactor and its terminal is effected without rubbing or sliding engagement between relatively movable parts, to the end that no lubricant is required.

Another object of this invention resides in the provision of a hermetically sealed variable resistor of the character described wherein the contactor comprises a light, flexible disc non-rotatably mounted at its center upon a post which serves as the terminal for the contactor, with the rim or marginal portion of the disc overlying the resistance element to have a localized portion thereof pressed into engagement with the resistance element by a rotatable pressure arm which bears upon the rim or marginal portion of the disc through a membrane forming a portion of an impermeable enclosure for the resistance element and contactor.

Still another object of this invention resides in the provision of a variable resistor of the character described wherein the base, the resistance element thereon, the terminals for the ends of the resistance element, the contactor and its terminal are assembled into a subassembly, all parts of which, with the exception of the terminals, are contained within a hermetically sealed enclosure.

With the above and other objects in view which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more

particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

The accompanying drawings illustrate one complete example of the physical embodiment of the invention constructed according to the best mode so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a longitudinal sectional view through a variable resistor embodying the principles of this invention;

Figure 2 is a disassembled perspective view of the two main sub-assemblies of the variable resistor of this invention, namely the resistor assembly and a mounting and actuator assembly; and

Figure 3 is a group perspective view of the components of the variable resistor assembly.

Referring now to the accompanying drawings, the numeral **4** designates generally the variable resistor of this invention, which comprises two main sub-assemblies, namely a variable resistor assembly **5** which contains the hermetically sealed elements of the device, described hereinafter, and a mounting and actuator assembly **6**.

The mounting and actuator assembly **6** comprises a shallow cup shaped cover **7** having a thimble **8** secured thereto to rotatably mount an actuating shaft **9** which projects from the front end of the thimble to be accessible for manipulation. The rear end of the shaft which is inside the cover has a driver **10** fixed thereto with its hub portion **10'** bearing against the adjacent end of the thimble to be thus supported against forward displacement with respect to the cover. Preferably, the driver is a sheet metal stamping formed to provide a rearwardly biased spring arm **11** with a rounded pressure applying shoe **11'** on its outer end, and a segment **12** opposite the arm and positioned to travel in an orbit intersected by a stop lug **13** on the cover. The engagement of the opposite side edges of the segment with the stop lug defines the limits of rotation of the driver; and the thimble provides means for mounting the entire unit upon a supporting panel.

The variable resistor assembly **5** includes a base **5'** of insulating material on which is mounted an arcuate resistance element **14**, a contactor **15** cooperable with the resistance element, and terminals **16** and **17** respectively connected with the resistance element and the contactor. The base **5'** is made of any suitable insulating material, but preferably has high heat resistance. Fibreglass and Bakelite are good for the purpose. The base has an integral forwardly projecting circumferential wall **18** and a coaxial forwardly projecting boss **19**. The arcuate resistance element **14**, which may be of the carbonaceous type, flatwise overlies the base and is secured thereto by the terminals **16** which extend through the resistance element, near the ends thereof, and through the base **5'** to project a substantial distance rearwardly from the base to provide for connection of conductors (not shown). Each terminal **16** has an integral circumferential flange **20** intermediate its ends providing a forwardly facing shoulder which cooperates with a peened head **21** on the front of the terminal to secure the resistance element to the base. A washer **22** may be confined between the head of each terminal **16** and the resistance element. A bore **25** in the base, extending partway into its circumferential wall **18** from the rear thereof, provides a small rearwardly facing ledge **26** under which a medial tab **27** on the resistance element is engaged to cooperate with the terminals **16** in securing the resistance element against displacement.

The contactor **15** is of thin, flexible metal and has a rim portion **29** and a central mounting portion or hub

31 to which the rim portion is integrally joined by means of a plurality of resiliently flexible arms 32. The mounting portion or hub 31 of the contactor is secured to the front of the boss portion 19 of the base by means of the terminal 17 which is substantially identical with the terminals 16 that secure the resistance element to the base. The rim portion of the contactor has a diameter such that it overlies the resistance element, but the boss 19 supports the contactor with its rim portion normally spaced a small distance forwardly from the resistance element. However, the rim of the contactor and the arms 32 are sufficiently resilient to permit the rim to be locally pressed into engagement with the resistance element, and to insure that the arms 32 will be as yielding as possible, to facilitate such flexing of the rim, each of the arms has a substantially S-shaped configuration to increase its effective length. To preclude rotation of the contactor, a small tang 33 is struck rearwardly out of its central mounting portion or hub 31, and engages in a radially outwardly opening slot 37 in the boss 19.

The members comprising the variable resistor assembly are hermetically sealed in an enclosure consisting of a flexible membrane 34, a rear sealing disc 35, and a metal clamping ring 36 which sealingly fastens the membrane and sealing disc to the base. The clamping ring snugly surrounds the edge of the base and has a radially inwardly projecting annular flange 38 at its front which overlies the marginal edge portion of the membrane 34 to clampingly seal the same against the front surface of the circumferential wall 18 on the base. The rear portion of the clamping ring projects axially behind the rear face of the base a substantial distance, as at 39, and is rolled radially inwardly to sealingly engage the edge of the disc 35 and to draw the flange 38 rearwardly against the membrane 34.

The rear sealing disc 35 is made of material (such as fully cured Silastic) which is impermeable to vapors. It has a diameter slightly larger than that of the base, and has sufficient rigidity so that as the rear portion of the clamping ring is rolled inwardly it engages the edge of the sealing disc under substantial compression to thus afford a vapor proof seal between the clamping ring and sealing disc. The terminals 16 and 17 extend through apertures in the rear sealing disc, but their medial flanges 20 clampingly engage the disc around the apertures and thus insure against the passage of fumes therethrough.

The flexible insulating membrane 34, overlying the front of the variable resistor assembly is made of a supple but impermeable material such as fully cured Silastic, Teflon or Mylar. Its diameter is substantially larger than that of the base so that its medial portion is substantially slack. The slack is not sufficient to allow the membrane to bear against the rim portion of the contactor and force the latter into contact with the resistance element, but it is sufficient so that the membrane will not interfere with transmission to the contactor of localized pressures from the pressure applying shoe 11' on the spring arm 11 of the driver 10. To further assure that the membrane 34 will not force the contactor against the resistance element and interfere with the setting of the resistor the boss 19 which supports the contactor projects forwardly a slightly lesser distance from the front face of the base than does the circumferential wall 18 against which the marginal edge portion of the front membrane is clamped.

The two sub-assemblies 5 and 6 are connected together and held in cooperative relation defined by the engagement of the rear edge of the cover side wall 7' adjacent the front of the ring 36, by ears 42 projecting forwardly from the ring 36, passing through slits 43 in the front wall of the cover and folded over as at 44. With the two subassemblies thus held together the pressure shoe 11' presses a localized portion of the contactor rim 29 against the resistance element, and as the shaft is rotated this localized point of contact of the contactor with the resistance element rolls along the length of the resistance element. But more important, this adjustment is effected without rubbing or sliding engagement between metal surfaces needing lubrication, since the connection between the contactor and its terminal (the center terminal 17) is permanently established in the fabrication of the resistor subassembly 5.

From the foregoing description taken together with the accompanying drawings it will be apparent that this invention provides a hermetically sealed variable resistor wherein the resistance element is protected from any fumes which may be present in the surrounding atmosphere and wherein no rubbing parts are located within the envelope enclosing the resistance element, so that no lubricant need be present inside said envelope, thus avoiding any possibility that high ambient temperatures might cause the lubricant to emit fumes which might damage the resistance element.

What is claimed as our invention is:

1. In a variable resistor, a hermetically sealed resistance element and contactor assembly comprising: a base of high heat resistant insulation; an arcuate resistance element overlying one face of the base; a flexible metal contactor having a substantially annular rim; means securing said contactor to the base with its rim overlying the resistance element and normally spaced thereabove, said means including resilient arms supporting the rim in a manner permitting localized portions thereof to be pressed into engagement with the resistance element; a flexible membrane of impermeable material overlying the contactor and the resistance element therebeneath; and means providing a hermetically sealed junction between the marginal edge portion of the membrane and the base, the securement of the membrane being such as to leave it medial portion substantially slack so that the position of the contactor with respect to the resistance element is not affected by the membrane, and so that pressure may be exerted through the membrane upon localized portions of the rim to press the same against the resistance element.

2. A variable resistor having a hermetically sealed resistance element and contactor assembly, said resistor comprising: a base of insulating material; an arcuate resistance element overlying one face of the base; a flexible metal contactor having a substantially annular rim; means securing said contactor to the base with its rim concentrically overlying the resistance element and normally spaced thereabove, said means including a terminal passing through and anchored to the base and a plurality of resilient arms extending from the terminal and supporting the rim of the contactor in a manner permitting localized portions thereof to be pressed into engagement with the resistance element; a flexible membrane of impermeable material; a sealing ring surrounding the marginal edge portion of the flexible membrane and clampingly sealing the same to the base with the membrane overlying the contactor and with the medial portion of the membrane substantially slack so that the position of the contactor with respect to the resistance element is not affected by the membrane and so that pressure may be exerted through the membrane upon localized portions of the rim to press the same against the resistance element; means carried by said sealing ring having a bearing at the face of the membrane remote from the resistance element and concentric therewith; a shaft rotatably journaled in said bearing and restrained against endwise movement in a direction away from the base; and a pressure applying arm carried by said shaft and projecting therefrom for wiping localized engagement of its free end portion with the rim of the contactor through the membrane.

3. The variable resistor of claim 2 further characterized by the fact that said means carried by the sealing ring comprises a cup-shaped cover which overlies the membrane and has its end wall spaced therefrom, and

a thimble secured to the end wall of said cover to provide the shaft bearing.

4. In a variable resistor, a hermetically sealed resistance element and contactor assembly comprising: a base of insulating material; an arcuate resistance element overlying one face of the base; a flexible contactor having a readily flexed rim portion of such diameter that it can overlie the resistance element; means securing the contactor to the base with its rim portion resiliently supported and concentrically overlying the resistance element in spaced relation thereto, said means permitting localized portions of the contactor rim portion to be pressed into engagement with the resistance element; and means providing an impermeable enclosure for said face of the base, the resistance element and the contactor, said means including a flexible membrane overlying the contactor and having its medial portion substantially slack so that the position of the contactor with respect to the resistance element is not affected by the membrane, and so that contact making pressure may be exerted through the membrane upon the contactor at localized points around the rim portion of the contactor.

5. In a variable resistor, the structure of claim 4 further characterized by the provision of an impervious sealing disc overlying the other face of the base; terminals for the resistance element passing through aligned holes in said sealing disc, base and the resistance element and having shoulders clamping the sealing disc, base and resistance element together and tightly sealing the holes in the disc through which the terminals pass; a center terminal passing through aligned holes in the sealing disc, base and a hub portion of the contactor and having shoulders between which the disc, base and contactor hub portion are clamped, one of said shoulders tightly sealing the hole in the sealing disc through which the center terminal passes; and common means tightly clamping

the edge portions of the membrane and the sealing disc to the base.

6. A variable resistor of the type having a resistance element and a movable contactor selectively engageable by adjustment thereof with different localized areas of the resistance element, characterized by the fact that the resistance element and movable contactor are hermetically sealed in an enlcosure having one wall provided by a flexible membrane of impermeable material; and further characterized by an actuator rotatably supported on said enclosure, at the exterior of the same, having a part cooperable with the movable contactor, through the flexible membrane to effect adjusting movement of the contactor as the actuator is rotated.

7. In a variable resistor: means defining a housing having sealed and unsealed sections, said means including a flexible membrane of impermeable material which divides the sealed and unsealed sections from one another and provides a portion of a hermetic enclosure for the sealed section; a resistance element mounted in the sealed section of the housing; a movable contactor in the sealed section of the housing, selectively engageable by adjustment thereof with different localized areas of the resistance element; and an actuator rotatably mounted in the unsealed section of the housing, said actuator including a member engageable, through said flexible membrane with the movable contactor to adjustingly move the same as the actuator is rotated.

References Cited in the file of this patent

UNITED STATES PATENTS

2,000,178	Kenney	May 7, 1935
2,023,382	Schellenger	Dec. 3, 1935
2,454,278	Gordy	Nov. 23, 1948
2,457,814	Gordy	Jan. 4, 1949
2,467,497	Ramos	Apr. 19, 1949