March 17, 1959 A. R. GARFINKEL ET AL 2,878,418

MINIATURE FILAMENTARY NUMERICAL DISPLAY

Filed June 4, 1958 4 Sheets-Sheet 1

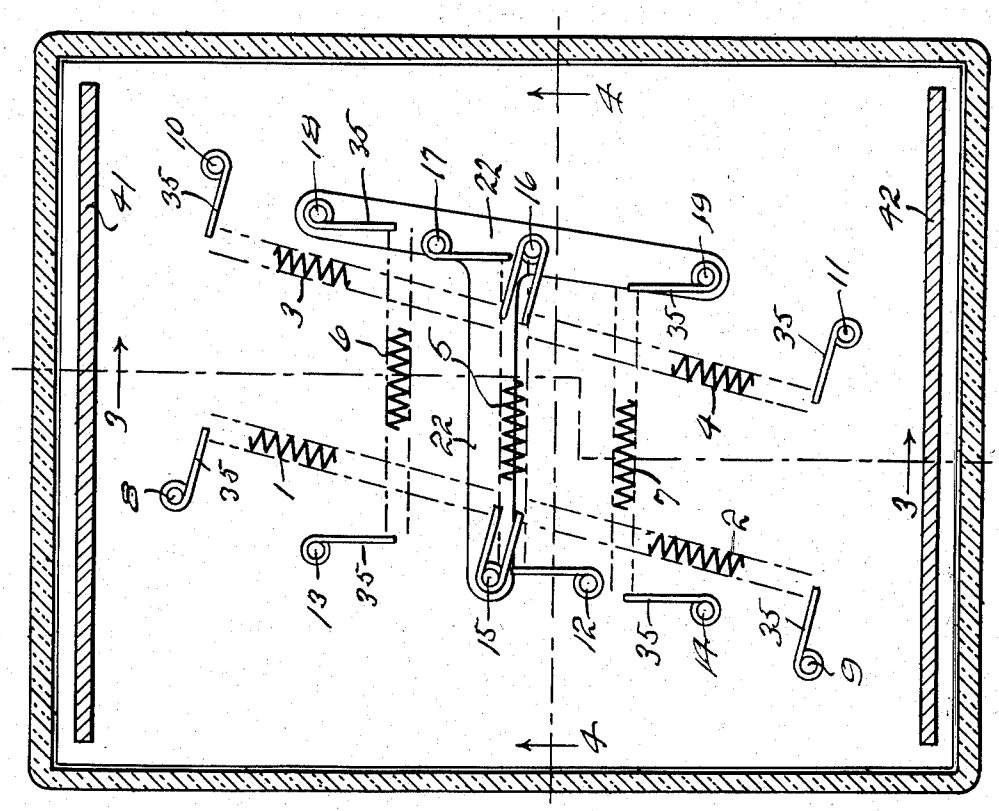


Fig. 2

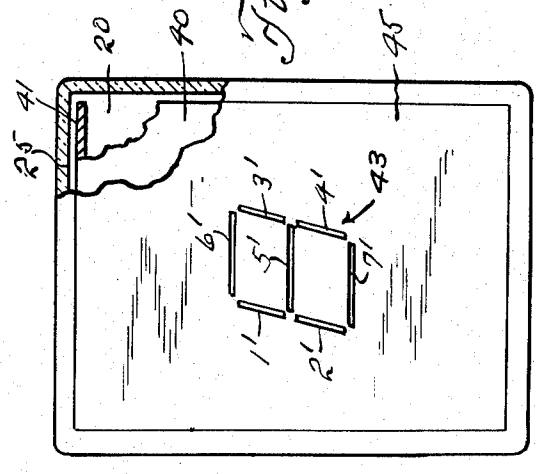


Fig. 1

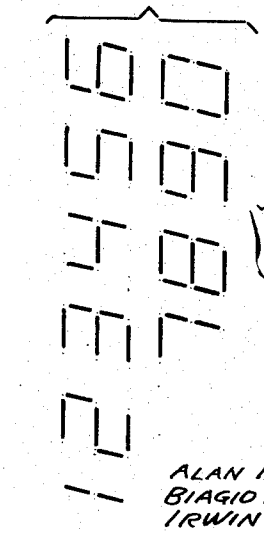


Fig. 8

INVENTORS
ALAN R. GARFINKEL
BIAGIO A. SPINELLI
IRWIN MUNT

BY Victor J. Borst

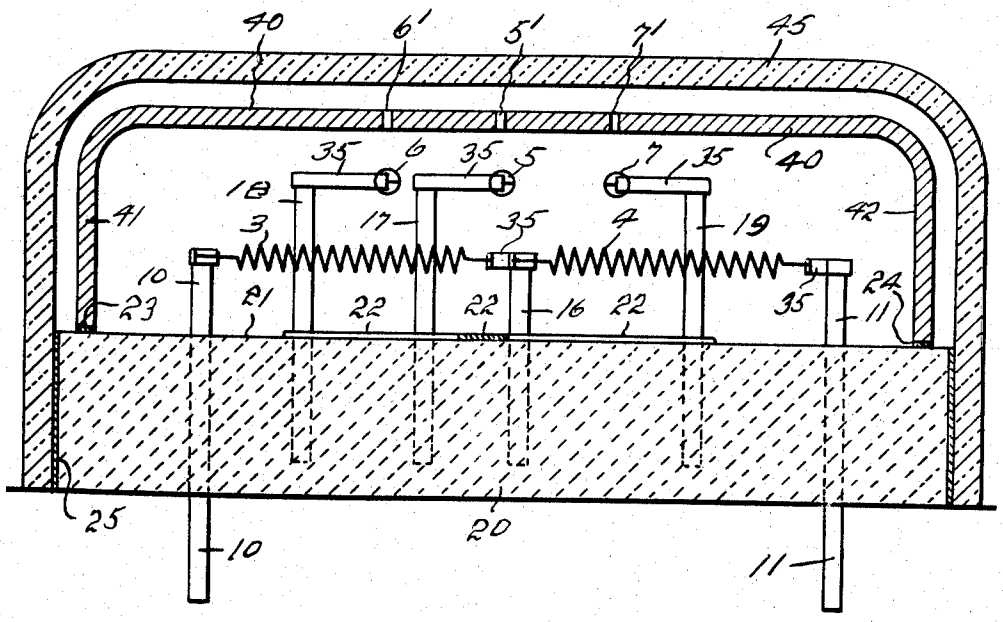
ATTORNEY

March 17, 1959 A. R. GARFINKEL ET AL 2,878,418

MINIATURE FILAMENTARY NUMERICAL DISPLAY

Filed June 4, 1958 4 Sheets-Sheet 2

Fig. 3



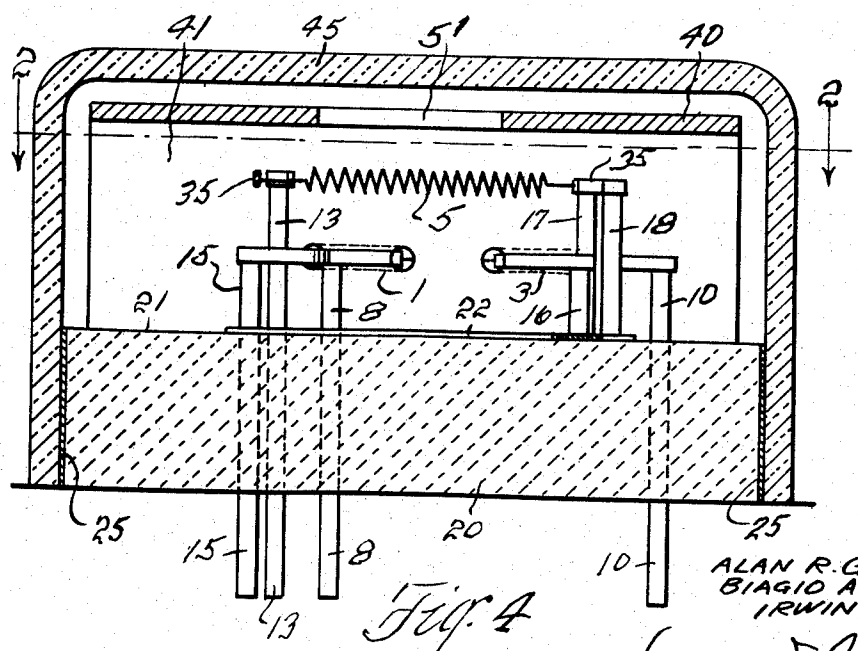


Fig. 4

INVENTORS
ALAN R. GARFINKEL
BIAGIO A. SPINELLI
IRWIN MUNT

BY Victor D. Borst

ATTORNEY

March 17, 1959 A. R. GARFINKEL ET AL 2,878,418

MINIATURE FILAMENTARY NUMERICAL DISPLAY

Filed June 4, 1958

4 Sheets-Sheet 3

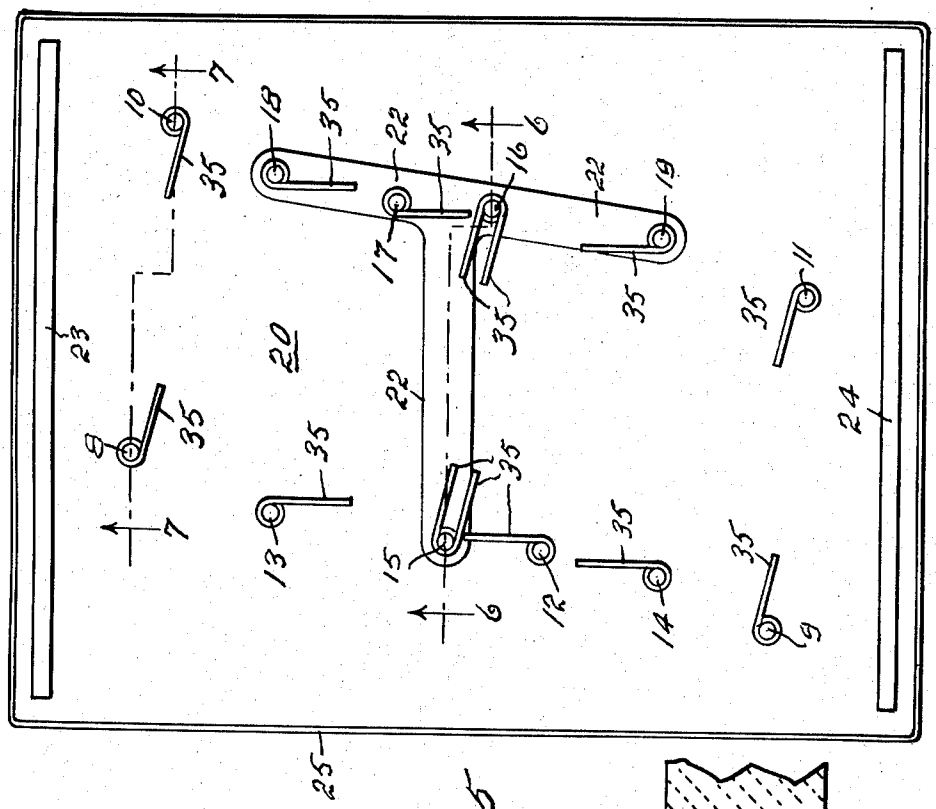


Fig. 5

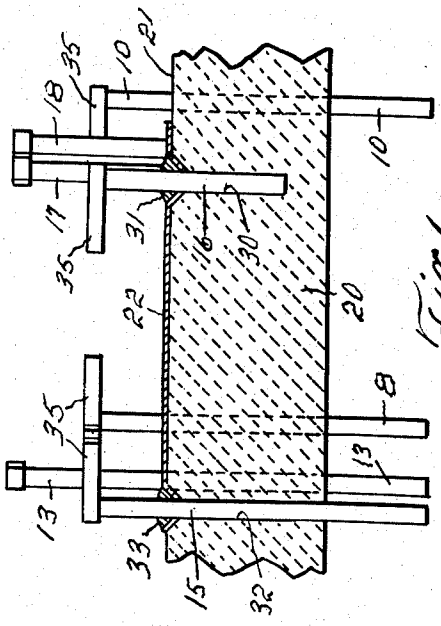


Fig. 6

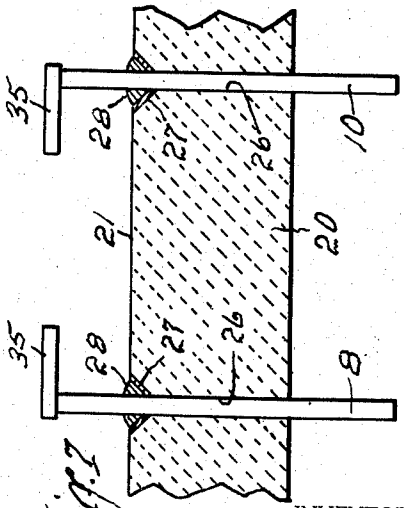


Fig. 7

INVENTORS
ALAN R. GARFINKEL
BIAGIO A. SPINELLI
IRWIN MUNT

BY Victor J. Borst

ATTORNEY

March 17, 1959 A. R. GARFINKEL ET AL 2,878,418

MINIATURE FILAMENTARY NUMERICAL DISPLAY

Filed June 4, 1958

4 Sheets-Sheet 4

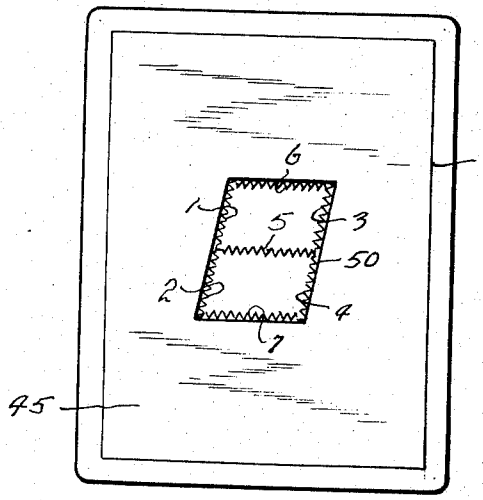


Fig. 9

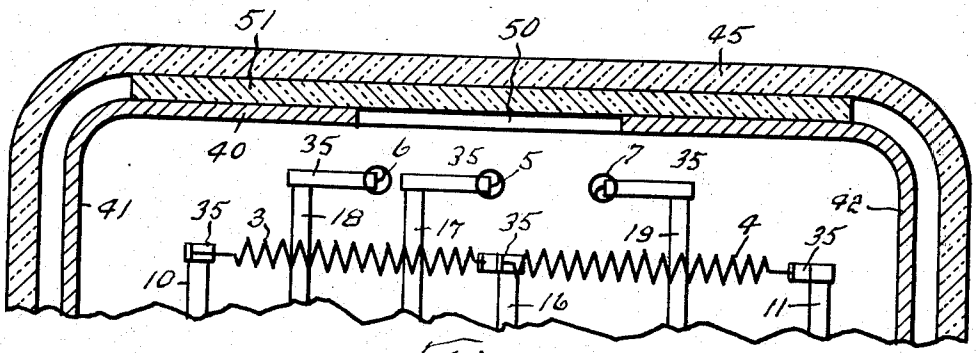


Fig. 10

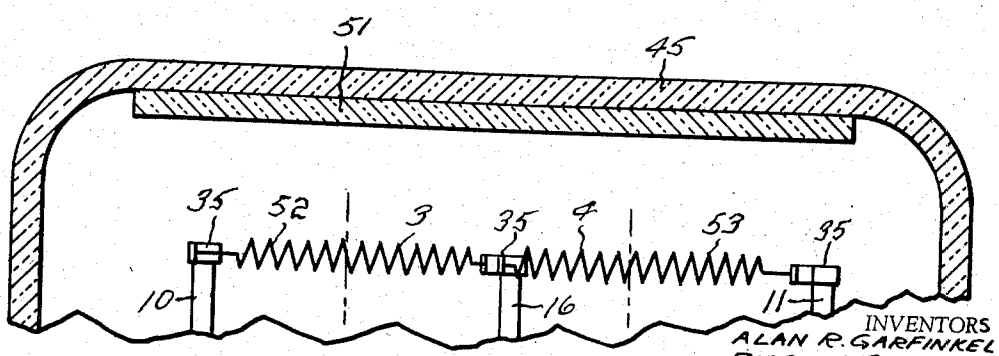


Fig. 11

INVENTORS
ALAN R. GARFINKEL
BIAGIO A. SPINELLI
IRWIN MUNT

BY Victor D. Borst

ATTORNEY

United States Patent Office 2,878,418
Patented Mar. 17, 1959

2,878,418

MINIATURE FILAMENTARY NUMERICAL DISPLAY

Alan R. Garfinkel, Forest Hills, Biagio A. Spinelli, Brooklyn, and Irwin Munt, Bronx, N. Y., assignors to Sperry Rand Corporation, Ford Instrument Company Division, Long Island City, N. Y., a corporation of Delaware

Application June 4, 1958, Serial No. 739,912

8 Claims. (Cl. 315—69)

This invention relates to a miniature filamentary numerical display device by which any numeral from zero (0) to nine (9) may be selectively electrically displayed. Devices of this character have many uses, one of which is to transmit information in numerical form from a remote source.

The device as shown herein is especially adapted for aircraft use where size and weight are prime factors, and comprises seven similar incandescent filament coils which are arranged to define two vertically adjacent diamond shaped areas. Two of these coils extend upwardly in axial alignment with each other at a slightly oblique angle, and a second pair of similarly arranged coils are disposed in spaced parallel relation thereto. The other three coils are horizontally disposed in spaced parallel relation to each other in a plane above and parallel to the plane of the upwardly extending coils, and extend across the upwardly extending coils. One of the horizontal coils is disposed across the adjacent ends of the two pairs of upwardly extending coils and the other two horizontal coils are disposed one on each side thereof.

These filament coils are secured to and supported in fixed position by twelve terminal posts which are mounted in and extend outwardly from a ceramic base having a fire glazed surface to render it impervious to gases. Seven of these posts constitute positive terminals and extend through the base and rearwardly therefrom for connection to sources of electric energy. The other five posts constitute negative or ground terminals which are all electrically connected together by a thin T-shaped metal layer which is bonded at high temperature to the ceramic base. Only one of the negative posts extends through the base for connection to a ground. The other four are merely embedded in the base.

An opaque, preferably metal, mask having rearwardly or downwardly extending flanges at the upper and lower ends thereof are disposed in front of and covers all of the filament coils. The mask is permanently secured to the base by soldering the ends of the flanges to metal strips bonded to the base, and is provided with window means through which light from energized coils is projected. This window means may comprise a plurality of narrow elongated slots through which light from energized coils is projected, there being one slot disposed in front of each coil in spaced parallel relation thereto; or it may comprise a rectangular opening of a size to encompass sections of all of the coils. By selectively energizing the proper combination of filaments any desired numeral may be displayed through the window means.

The whole assembly is enclosed in an evacuated transparent glass envelope which is hermetically sealed to the base.

The principal object of the invention is to provide a numeral display device having a high speed of operation and which is small in size and of light weight, can be viewed through a 90° cone with little or no parallax and

distortion, has low power requirements and will satisfy military instrument lighting requirements for aircraft.

Having stated the principal object of the invention, other and more limited objects thereof will be apparent from the following specification and the accompanying drawings forming a part thereof in which:

Fig. 1 is a plan view of a numerical display device constructed according to our invention;

Fig. 2 is an enlarged horizontal sectional view the plane of which is indicated by the line 2—2 on Fig. 4;

Fig. 3 is a vertical sectional view taken substantially on the line 3—3 of Fig. 2;

Fig. 4 is a vertical sectional view taken substantially on the line 4—4 of Fig. 2;

Fig. 5 is a plan view of the base showing it before the filament coils, mask and envelope have been mounted thereon;

Fig. 6 is a fragmentary detail section taken on the line 6—6 of Fig. 5;

Fig. 7 is a fragmentary detail section taken on the line 7—7 of Fig. 5;

Fig. 8 is a view showing the formation of the numerals zero (0) to nine (9) as displayed by the device;

Fig. 9 is a view similar to Fig. 1 showing a different type of window means through which light from energized coils is projected;

Fig. 10 is a view similar to Fig. 3 showing a translucent plate having a light diffusing surface mounted on the mask within the enclosing envelope; and

Fig. 11 is a fragmentary detail sectional view of a modified form of the invention which is so constructed that the need for a mask is eliminated.

The display device as illustrated in Figs. 1 to 11 is of minute size, and consequently for clearness of illustration the scale of the drawings is greatly enlarged, Figs. 1 and 9 being approximately five times actual size, Figs. 2 to 7 and 10 and 11 being twice the size of Figs. 1 and 9 or approximately ten times actual size, and the scale of Fig. 8 being approximately one half the scale of Figs. 1 and 9 or two and one half times actual size.

Referring now to the drawings by reference characters, the display device as shown herein comprises seven similar incandescent filament coils which are designated by the numerals **1**, **2**, **3**, **4**, **5**, **6** and **7**, respectively. These coils are preferably formed of .001 inch diameter tungsten wire, there being eight hundred (800) convolutions per inch of .005 inch diameter. The coils **1** to **7** are secured to and supported in fixed position by positive terminal posts designated **8**, **9**, **10**, **11**, **12**, **13** and **14** respectively, and negative or ground terminal posts designated **15**, **16**, **17**, **18** and **19**, respectively. The terminal posts **8** to **19** inclusive are mounted in fixed position on a ceramic base plate **20** having a fire glazed surface **21** by which it is rendered impervious to gases. The glazed surface **21** of the base **20** is provided with a T-shaped thin metal layer **22** and two elongated rectangular thin metal layers **23** and **24** which are bonded thereto under high temperature. The periphery of the base plate **20** is also provided with a thin metal layer **25** which is similarly bonded thereto.

The positive terminal posts **8** to **14** are all disposed in apertures **26** which extend through the base plate **20** so that the posts **8** to **14** may extend out beyond the rear face of the base plate for connection to sources of electrical energy. The chamfered upper ends of the apertures **26** are metalized as indicated at **27** to which the posts are hard soldered as indicated at **28**. The negative terminal posts **16**, **17**, **18** and **19** are all mounted in sockets **30** in the base **20** which are disposed below apertures in the metal layer **22**, about which the posts **16** to **19** are hard soldered to the metal layer as indicated at **31**. The negative terminal post **15** is mounted in and ex-

tends out through a bore 32 in the base 20 for connection to a ground. The bore 32 is disposed below an aperture in the metal layer 22 about which the post 15 is hard soldered to the metal layer 22 as indicated at 33. It will therefore be seen that all of the negative posts 15 to 19 are electrically connected together by the metal layer 22, and that they are all adapted to be connected to a common ground through the metal layer 22 and terminal post 15. All of the terminal posts 8 to 19 are preferably, but not necessarily, made of tungsten having a coefficient of expansion substantially the same as that of the ceramic base 20. The upper ends of the terminal posts are all provided with outwardly extending arms 35 through which the filament coils 1 to 7 are connected to their respective posts.

The coil 1 is connected to and between the positive post 8 and the negative post 15; the coil 2 is connected to and between the positive post 9 and the negative post 15; the coil 3 is connected to and between the positive post 10 and the negative post 16, and the coil 4 is connected to and between the positive post 11 and the negative post 16. It will therefore be seen that the negative post 15 is common to the coils 1 and 2, and that the negative post 16 is common to the coils 3 and 4. The coil 5 is connected to and between the positive post 12 and the negative post 17; the coil 6 is connected to and between the positive post 13 and the negative post 18, and the coil 7 is connected to and between the positive post 14 and the negative post 19. The coils 1, 2, 3 and 4 are all disposed in a common plane which is parallel to and vertically spaced from the upper surface of the base 20; and the coils 5, 6 and 7 are disposed in a common plane which is parallel to the plane of the coils 1 to 4 and is disposed thereabove in vertically spaced relation thereto.

As shown in Fig. 2, the coils 1 and 2 are disposed in axial alignment with each other and extend upwardly at a slightly oblique angle; and the coils 3 and 4 are similarly disposed in laterally spaced parallel relation to the coils 1 and 2. The coils 5, 6 and 7 are disposed transversely of the coils 1 to 4, with the coil 5 extending between the adjacent ends of the coils 1 and 2 and the adjacent ends of the coils 3 and 4. The coil 6 is disposed on one side of the coil 5 in spaced parallel relation thereto; and the coil 7 is disposed on the other side of the coil 5 in spaced parallel relation thereto. The arrangement of the coils 1 to 7 is therefore such that they define two adjacent diamond shaped similar parallelograms with the coil 5 common to both.

An opaque mask 40, preferably black surfaced copper or tin, is disposed over the filament coils 1 to 7 in spaced parallel relation thereto. The mask 40 is provided with downturned flanges 41 and 42 at the upper and lower ends thereof by which the mask is permanently secured to the base 20 in fixed position by hard soldering the lower ends of the flanges 41 and 42 to the complementary metal layers 23 and 24, respectively, which are bonded to the base 20. The mask 40 is provided with window means 43 comprising elongated narrow slots 1', 2', 3', 4', 5', 6' and 7', which are disposed over and in vertically spaced parallel alignment with the incandescent filament coils 1 to 7, and are aranged to define two adjacent diamond shaped parallelograms which are coextensive with the parallelograms defined by the coils 1 to 7. As shown by Figs. 1 and 2, the slot 1' is disposed over and is coextensive with the portion of the coil 1 which extends between the coils 5 and 6; the slot 2' is disposed over and is coextensive with the portion of the coil 2 extending between the coils 5 and 7; the slot 3' is disposed over and is coextensive with the portion of the coil 3 extending between the coils 5 and 6; the slot 4' is disposed over and is coextensive with the portion of the coil 4 extending between the coils 5 and 7; the slot 5' is disposed over and is coextensive with the portion of the coil 5 extending between the adjacent ends of the coils 1 and 2 and the adjacent ends of the coils 3 and 4; the slot 6' is disposed over and is coextensive with the portion of the coil 6 extending between the coils 1 and 3, and the slot 7' is disposed over and is coextensive with the portion of the coil 7 extending between the coils 2 and 4. Whenever any coil 1 to 7 is energized a narrow line of light therefrom will be projected through the associated slots 1' to 7'.

The whole assembly thus far described is enclosed in a transparent envelope 45, preferably glass, which is hermetically sealed to the metalizing 25 around the periphery of the base 2 and evacuated.

The manner in which various combinations of incandescent filament coils 1 to 7 are energized to illuminatingly display each of the numerals zero (0) to nine (9) as shown in Fig. 8 will now be described. For the numeral one (1) the coils 3 and 4 are energized; for the numeral two (2) the coils 2, 3, 5, 6 and 7 are energized; for the numeral three (3) the coils 3, 4, 5, 6 and 7 are energized; for the numeral four (4) the coils 1, 3, 4 and 5 are energized; for the numeral five (5) the coils 1, 4, 5, 6 and 7 are energized; for the numeral six (6) the coils 1, 2, 4, 5, 6 and 7 are energized; for the numeral seven (7) the coils 3, 4 and 6 are energized; for the numeral eight (8) all of the coils 1 to 7 are energized; for the numeral nine (9) the coils 1, 3, 4, 5, 6 and 7 are energized, and for zero (0) the coils 1, 2, 3, 4, 6 and 7 are energized.

In use either only one display device as shown herein or a plurality thereof arranged side by side in a row may be used. It all depends on the particular use. If numbers greater than 9 are to be displayed a plurality of units are used, and the number of units to be used is dependent upon the number of digits in the highest number to be displayed.

In Fig. 9 we have shown a slightly different type of window means 43 in the mask 40, through which light from energized coils is projected. As shown therein we substitute a single rectangular window 50 for the window slots 1' to 7'. The window 50 is of such a size as to encompass only such sections of the coils 1 to 7 as are utilized in forming numerals. The window 50 extends from slightly above the coil 6 to slightly below the coil 7, and from the outside of the coils 1 to 2 to the outside of the coils 3 and 4. The unused sections of the coils 1 and 3 above the coil 6, and the unused sections of the coils 2 and 4 below the coil 7 are therefore blocked out.

In Fig. 10 we have shown a translucent plate 51, having a light diffusing surface, applied to the top of the mask 40. The plate 51 is preferably ground glass and may be used with either the window means shown in Fig. 1 or that shown in Fig. 9.

In Fig. 11 we have shown a modification of the display device in which the need for a mask to block out unused sections of the coils is eliminated. In this form of the device the positive terminal posts 8 to 14 and negative terminal posts 15 to 19 for the coils 1 to 7 respectively, constitute heat sinks which are operative to prevent incandescence of the unused end sections 52 and/or 53 of a coil. Therefore only that section of a coil which is used in forming a numeral will be rendered incandescent when a coil is energized. As in the other forms of the invention, this form is enclosed in the evacuated envelop 45. Also the translucent plate 51 may be used therewith if desired.

From the foregoing it will be apparent to those skilled in this art that we have provided a very simple and efficient numeral display device which accomplishes the objects of the invention.

It is to be understood that we are not limited to the specific construction shown and described herein, as various modifications may be made therein within the spirit of the invention and the scope of the appended claims. For instance, the device may be any size and not necessarily the minute size described herein. Also the adjacent parallelograms defined by the filament coils may be square instead of diamond shaped as shown

herein. Furthermore, electroluminescence, catholuminescence, or gaseous glow phenomena may be substituted for the incandescent filament coils shown and described herein; and the plane of the coils **1** to **4**, and the plane of the coils **5** to **7** may be reversed.

What is claimed is:

1. A numerical display device of the character described comprising a non-conductive impervious base, a plurality of filament coils arranged to define two vertically disposed adjacent similar parallelograms with one of said coils being common to both of said parallelograms, a pluarity of positive and negative terminal posts by which said coils are supported in fixed position, each of said coils being secured to and between the upper ends of a positive and negative terminal post, said terminal posts being secured to said base and extending upwardly therefrom, said coils being adapted to be selectively energized through said terminal posts to illuminatingly display a selected numeral, an opaque mask secured to said base and disposed over said coils, a window in said mask through which light from said coils is projected, and a transparent evacuated envelope in which said coils and said masks are enclosed, said envelope being hermetically sealed to said base.

2. A numerical display device as defined by claim 1 in which all of said positive terminal posts extend through said base for connection to sources of electrical energy, and in which said negative terminal posts are all connected together by a thin metallic layer bonded to said base with only one of said negative posts extending through said base for connection to a ground.

3. A numerical display device as defined by claim 2 in which said positive and negative terminal posts constitute heat conduction elements which are operative to prevent incandescence of the end section of said coils when said coils are energized.

4. A numerical display device as defined by claim 1 in which a translucent plate having a light diffusing surface is disposed over said mask within said envelope.

5. A numerical display device of the character described comprising a non-conductive impervious base, a plurality of similar filament coils one pair of which are disposed in upwardly extending axial alignment with each other, a second pair of which are similarly disposed in spaced parallel relation to said one pair, said other coils being horizontally disposed in a plane spaced from and parallel to the plane of said upwardly extending coils with one of

said other coils being disposed in horizontal alignment with and extending between the adjacent ends of said one pair of coils and said second pair of coils, and the other of said other coils being disposed in spaced parallel relation to said one other of said other coils, one on each side thereof and extending between said one pair of coils and said second pair of coils, a plurality of positive and negative terminal posts by which said coils are supported in fixed position, each of said coils being secured to and between the upper ends of a positive and negative terminal post, said terminal posts being secured to said base and extending upwardly therefrom, said coils being adapted to be selectively energized through said terminal posts to illuminatingly display a selected numeral, an opaque mask secured to said base and disposed over said coils, a window in said mask through which light from said coils is projected, and a transparent evacuated envelope in which said coils and said mask are enclosed, said envelope being hermetically sealed to said base.

6. A numerical display device as defined by claim 5 in which all of said positive terminal posts extend through said base for connection to sources of electrical energy, and in which said negative terminal posts are all connected together by a thin metallic layer bonded to said base with only one of said negative posts extending through said base for connection to a ground.

7. A numerical display device as defined by claim 6 in which said positive and negative terminal posts constitute heat conduction elements which are operative to prevent incandescence of the end section of said coils when said coils are energized.

8. A numerical display device as defined by claim 5 in which a translucent plate having a light diffusing surface is disposed over said mask within said envelope.

References Cited in the file of this patent

UNITED STATES PATENTS

573,088	Hawkins	Dec. 15, 1896
740,585	O'Brien	Oct. 6, 1903
1,156,967	Appleyard	Oct. 19, 1915
1,428,424	Fehler	Sept. 5, 1922
1,819,690	Ricker	Aug. 18, 1931
2,735,038	Hancock	Feb. 14, 1956

FOREIGN PATENTS

210,289	Great Britain	Feb. 4, 1924