Nov. 26, 1963 F. BUDRECK 3,111,736

SEPARABLE TWO-PART MAGNETIC CONNECTOR

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Fig. 1.

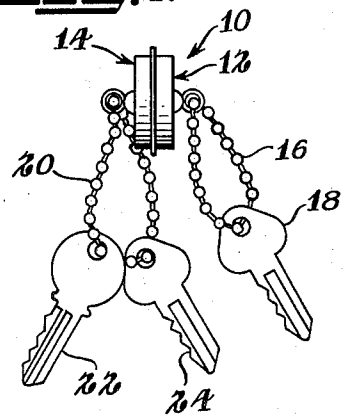


Fig. 2.

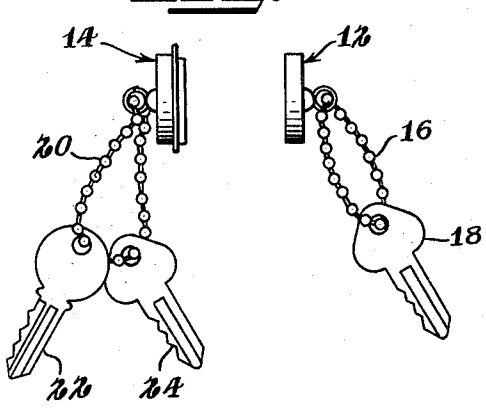
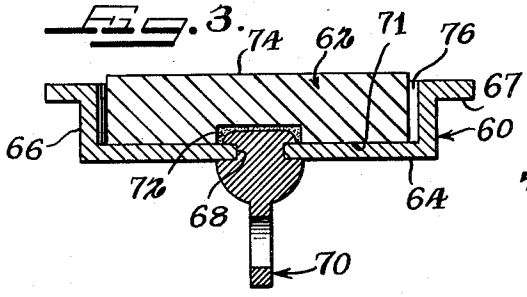


Fig. 3.



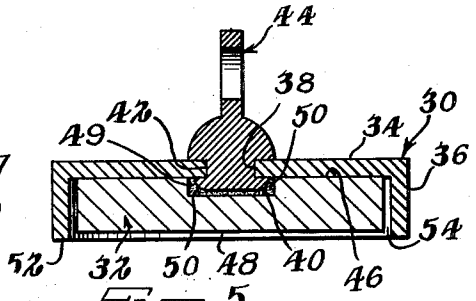
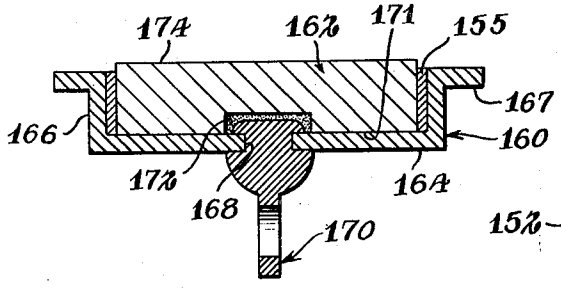


Fig. 5.

Fig. 9.



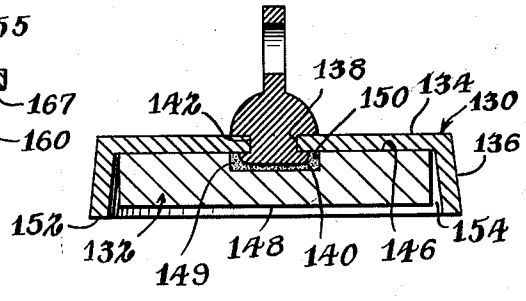


Fig. 8.

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SEPARABLE TWO-PART MAGNETIC CONNECTOR

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Fig. 4.

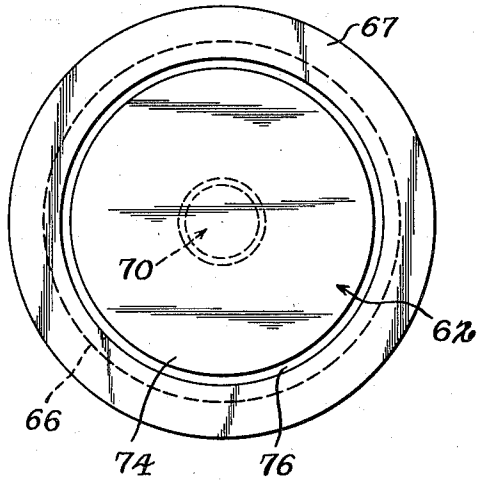
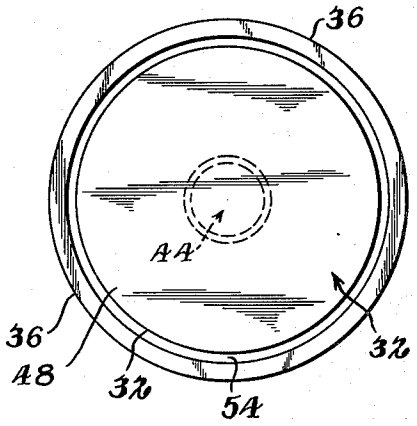


Fig. 6.



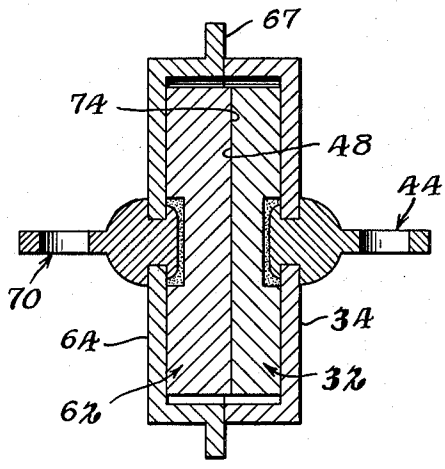


Fig. 7.

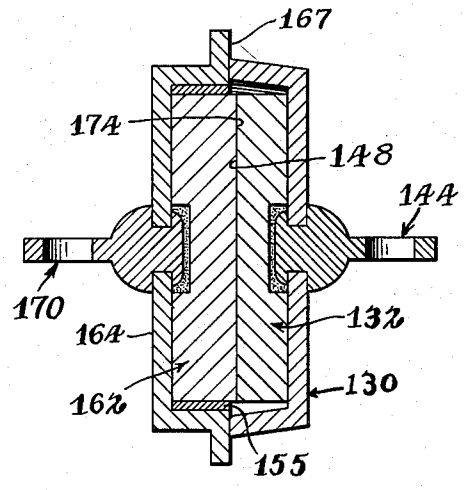


Fig. 10.

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United States Patent Office 3,111,736 Patented Nov. 26, 1963

3,111,736

SEPARABLE TWO-PART MAGNETIC CONNECTOR

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Filed Dec. 7, 1961, Ser. No. 157,754
8 Claims. (Cl. 24—201)

The improved separable two-part magnetic connector comprising the present invention has been designed for use primarily as an automotive key chain connector of the type which utilizes separable key chain assemblies consisting of two independent key chains. One of the key chains is adapted to retain a single ignition key and the other key chain is adapted to retain a reserve ignition key, a glove compartment and trunk key, and any other miscellany of keys which the owner may see fit to include with his assembly of automotive keys. The two chains are releasably connected together, usually by a push-pull snap connection so that upon leaving an automotive vehicle in a public parking place, the single ignition key may be left in the ignition lock for use by the attendant while the chain containing the single reserve ignition key and glove compartment and trunk key may be retained by the vehicle owner. The attendant is thus precluded from access to either the glove compartment or the trunk but he is able to operate the vehicle.

Besides the conventional and well-known push-pull snap type of separable key connector, there have recently appeared on the market several different two-part magnetic key chain connectors, each of these being in the form of a magnetic assembly which constitutes one of the parts, and an armature assembly which constitutes the other part. While such connectors constitute improvements over the push-pull snap connectors, they still are possessed of certain limitations which is the aim of the present invention to overcome.

One advantage of a magnetic connector resides in the fact that the owner, who usually retains the magnetic part while leaving the armature part with the attendant, has at all times in his possession and at his disposal a small permanent magnet assembly which he may use as he sees fit to pick up small magnetic articles such as pins or nails, to test or distinguish ferrous articles or materials from nonferrous articles or materials, to attach the reserve key chain in a concealed place, as, for example, beneath the cowl or a fender if he does not choose to carry the assembly with him, or otherwise to use the magnet in any manner in which small permanent magnet assemblies are customarily used. In the case of magnetic connectors employing a magnet part and an armature part, this advantage does not accrue to the garage or parking lot attendant who has only a nonmagnetic armature part in his possession. He cannot dispose of the key chain associated therewith by attaching the armature to a magnetic part of the vehicle, and since usually he leaves the key chain in the particular vehicle with which it is associated, he must conceal it beneath the floor mat or behind the sun visor as he ordinarily does in connection with push-pull snap-type connectors. According to the present invention, the improved magnetic separable connector utilizes permanent magnet assemblies for both parts, and by reason of this, both the owner and the parking lot attendant has at his disposal a magnet for attaching purposes. The attendant may thus attach his part conveniently in an out-of-the-way place within the vehicle by merely applying the magnet to some magnetic part of the vehicle, as, for example, the steering column or the cowl. Furthermore, by employing two mutually attractable magnets, an appreciably greater magnetic holding force is attained than when one of the parts is in the form of an armature.

Another and even more important advantage of the present invention resides in the physical construction of

the two permanent magnet assemblies which are so designed that they are self-centering. By "self-centering" is meant the ability of the two parts to mate accurately when magnetically coupled so that the meeting rims of both parts automatically move into register without manual guidance or assistance, thus bringing the two magnets into their fully coupled relationship so as to attain the maximum magnetic attraction and holding power between the two parts, as well as to prevent any magnetic overlap which might, in the pocket or purse of the user, establish an outside magnetic field with a consequent attraction of the assembly to other metallic articles such as a pocket knife, hair pins and the like. Still further, because of this self-centering feature of the invention, it is possible to reunite the two parts of the separable magnetic assembly with one of the parts suspended from its respective key chain while the latter is, in turn, suspended from the ignition key within the lock on the automobile cowl, merely by manually bringing the other part into close proximity to the suspended part, at which time the two parts will automatically seek each other, so to speak, and become accurately coupled and centered upon each other. The operation may be performed in the dark and it is not necessary for the operator to touch the suspended part.

The invention further contemplates the provision of a physical interlock between the two magnetic parts, such interlock being effective to prevent lateral shifting of one part relatively to the other part after the parts have become fully coupled. Because of the self-centering feature of the invention as briefly outlined above, such interlock also becomes automatically effective when the two parts are brought into close proximity with each other and without requiring any manipulation of either part other than to move it into such position of close proximity with only a rough degree of orientation.

A still further feature of the present invention, in a two-part separable magnetic connector of this type, is the provision of two counterpart magnet assemblies, each including a permanent magnet and a pole cup within which the magnet is nested, the rim region of the pole cup within which the magnet is nested, the rim region of the pole cup being spaced from the body of the magnet to afford an air or other dielectric gap in the magnetic flux circuit of the magnet, the widths of the two gaps associated with the assemblies respectively being of different magnitude, thus enhancing the self-centering feature of the separable connector by means of certain phenomena which will be set forth subsequently.

The provision of a two-part separable connector such as has briefly been outlined above being among the principal objects of the invention, numerous other objects and advantages will become readily apparent as the nature of the invention is better understood.

In the accompanying two sheets of drawings forming a part of this specification, two illustrative embodiments of the invention have been shown.

In these drawings:

FIG. 1 is a side elevational view of a separable key chain assembly embodying the principles of the present invention and showing the same in its coupled condition;

FIG. 2 is a side elevational view similar to FIG. 1 and showing the two parts of the assembly uncoupled and slightly separated;

FIG. 3 is an enlarged sectional view taken substantially along the line 3—3 of FIG. 2;

FIG. 4 is an end view of the structure shown in FIG. 3;

FIG. 5 is a sectional view taken substantially along the line 5—5 of FIG. 2;

FIG. 6 is an end view of the structure shown in FIG. 5;

FIG. 7 is an enlarged sectional view taken substantially along the line 7—7 of FIG. 1;

FIG. 8 is a sectional view similar to FIG. 3 but showing a slightly modified form of magnetic assembly;

FIG. 9 is a sectional view similar to FIG. 5 but showing a counterpart magnetic assembly for the assembly of FIG. 8; and

FIG. 10 is a sectional view similar to FIG. 7 and showing the assemblies of FIGS. 8 and 9 magnetically coupled.

Referring now to the drawings in detail, and in particular to FIGS. 1 and 2, wherein the invention has been shown as being applied to a separable key chain assembly, the assembly has been designated in its entirety by the reference numeral 10 and involves in its general organization two separable parts 12 and 14, respectively, each in the form of a permanent magnet assembly. The part 12 has associated therewith a conventional ball and link chain 16 carrying an automobile ignition key 18, while the part 14 has associated therewith a similar key chain 20 carrying a reserve ignition key 22 and a trunk lock key 24. As will be described in greater detail presently, the parts 12 and 14, when disposed in approximate alignment and positions of close proximity, are attracted to each other so that the respective magnets associated with the two parts become magnetically coupled whereby the key chains 16 and 20 are held together as a unit but are capable of being separated from each other merely by pulling the same apart so that the magnets will become magnetically uncoupled.

The key chains 16 and 20 and the various keys illustrated herein are conventional and no claim is made to any novelty associated therewith. Neither is any novelty predicated upon the releasable attachability of the two key chains to each other inasmuch as separable key chains designed for the same purpose and embodying mechanical spring detent means for their separation are well-known in the art. The invention consists rather in the novel construction, combination, and arrangement of parts of the permanent magnet assembly 12, 14 which possesses both physical and magnetic features that contribute toward the efficiency of the assembly, especially when it is employed as a separable key chain connector.

Referring now specifically to FIGS. 3, 4 and 7, the permanent magnet assembly which constitutes the part 12 may assume various external configurations, but in the embodiment illustrated herein, it is of circular cross section throughout. The assembly includes two principal parts, namely, an outer pole cup 30 in the form of an open cup-shaped shell and an inner permanent magnet 32 which is centered and nested within the pole cup 30. The pole cup 30 is formed of a magnetic material such as mild steel, while the magnet 32 is a ceramic magnet of the mixed ferrite type, such magnets being a comparatively recent development in the field of permanent magnet construction and possessing greatly improved properties over permanent magnets which are constructed of metallic alloys.

One such magnetic material capable of being employed in connection with the present invention for construction of the magnet 32 is the material known as "Indox," a development of Indiana Steel Products Company of Valparaiso, Indiana. This barium-ferrite material is characterized by the fact that it is electrically nonconductive. The material is extremely resistant to demagnetizing influences and evidences very low eddy current losses. Indox is a magnetic material which exhibits extremly high coercive force, a low remanence and high permeability. Because of the characteristics of this permanent magnetic material, the magnetic length of a magnet constructed therefrom need be but a fraction of that required for the ferrous alloys in attaining the same magnetic pull for a given magnet size. Where barium-ferrite ceramic materials are concerned, magnetic stability is pronounced and permanent magnets of this character maintain their magnetic strength despite weakening influences, such as contact with extraneous

magnetic fields and frequent removal and replacement of magnetic armatures. Additionally, Indox and like ceramic materials are relatively light as compared to the magnetic alloys. As a magnetic material for holding purposes, the shape characteristics and small sizes which Indox and similar materials may assume for any given attractive power leave little to be desired. For example, such magnetic materials satisfy the requirements of releasable holding devices for refrigerator doors and the like where space is at a premium, where high holding power is required, and where frequent armature or intermagnet attraction and release is encountered. Ceramic magnets of this type are extremely effective, even when they are of thin wafer-like design and, accordingly, the magnet 32 illustrated herein is of relatively thin, flat construction and, therefore, the shell or pole piece 30 is of shallow design.

Still referring to FIGS. 3, 4 and 7, the pole cup 30 is provided with a flat bottom wall 34 and an upstanding cylindrical side wall 36. The bottom wall 34 is formed with a central aperture 38 therein in which there is riveted as at 40 the stem portion 42 of an eyelet post 44 to which the key chain 16 may be removably attached.

The ceramic magnet 32 is in the form of a relatively thin disk which is magnetized as shown in FIG. 3 to provide poles of opposite polarity on the opposite pole faces 46 and 48 thereof. The face 46 is cemented as at 49 to the bottom wall 34 of the pole cup 30 and is formed with a shallow socket 50 for clearance purposes, the riveted portion 40 of the eyelet post 44 being disposed within this socket. The axial extent of the magnet 32, i.e., its thickness, is slightly less than the height of the cylindrical side wall 36 of the pole cap 30 so that the transverse plane of the open circular rim 52 of the wall 36 is spaced forwardly a slight distance from the planar forward pole face 48 of the magnet 32, these dimensional features which result in a recessing of the magnet face 48 in the pole cup 30 being for purposes that will be explained presently. The diameter of the magnet 32 is slightly less than the inside diameter of the side wall 36 so that a narrow annular space 54 is created between the cylindrical surface 56 of the magnet and the wall 36. This space 54 establishes a narrow dielectric gap in the flux path of the magnet in the vicinity of the pole face 48.

Referring now to FIGS. 5, 6 and 7, the permanent magnet assembly which constitutes the part 14 is of circular cross section throughout and includes two principal parts, namely, an outer pole cup 60 in the form of an open cup-shaped shell and an inner permanent magnet 62 centered and nested within the pole cup. The pole cup 60 is formed of a magnetic material, such as mild steel, and the magnet 62 is of the ceramic type and, like the magnet 32, may be formed of Indox. The pole cup 60 is provided with a flat bottom wall 64 and an upstanding cylindrical side wall 66. The rim region of the side wall 66 is formed with an outwardly extending flat rim flange 67 of appreciable width. An aperture 68 formed centrally in the bottom wall serves to accommodate attachment of an eyelet post 70 similar to the eyelet post 44. The magnet 62 has its inside face 71 cemented to the bottom wall 64, the face being recessed as at 72 to accommodate the eyelet post 70 as is the case in connection with the part 12. The axial extent or thickness of the magnet 62 is slightly greater than the height of the cylindrical side wall 66 of the pole piece 60 so that the transverse plane of the rim flange 67 on the wall 66 is disposed slightly rearwardly of the forward pole face 74 of the magnet. The magnet 62 thus projects a slight distance forwardly of the flange 67, the extent of its projection being substantially to the extent by which the face 48 of the magnet 32 is recessed in the pole cup 30 of the part 12. The diameter of the magnet 62 is less than the inside diameter of the cylindrical wall 66 so that a narrow annular space 76 is created between the outside cylindrical surface of the magnet and the wall 66, the width of the space

76 being slightly less than the width of the corresponding annular space 54 associated with the part 12.

As shown in FIG. 7, when the parts 12 and 14 are magnetically coupled, the open circular rim 52 of the pole cup 30 seats against the flat annular flange 67 while the outer end of the magnet 62 projects into the rim 52 of the pole cup 30 so that the two pole faces 48 and 74 of the magnets 32 and 62 respectively meet each other in face-to-face contact with the two magnets being fully magnetically coupled. The magnetic flux of the magnet 32 is concentrated in the rim region of the pole cup 30 and an appreciable portion of the total attractive force between the two magnetic parts 12 and 14 resides in the mutual attraction between the circular rim 52 and the flange 67 against which it seats. Since there is a high flux concentration in both the circular rim 52 and the flange 67, and since the polarities involved at these regions are opposite, there will be an appreciable degree of mutual attraction between the parts.

With the parts thus magnetically coupled as shown in FIG. 7, and as described above, there can be no appreciable amount of lateral shifting of one part upon the other due to the fact that the magnet 62 projects into the rim 52 of the pole cup 30. It is to be noted, however, that some lateral shifting make take place, the amount of such shifting being a function of the difference between the diameters of the magnet 62 and the cylindrical wall 36. The diameters of the two magnets 32 and 62 are the same and, where two cylindrical magnets of the same size are brought into close proximity with pole faces of opposite polarity facing each other, there is a natural tendency for the two magnets to center themselves, i.e., to become coaxial, as they exert their mutual attraction upon each other. Invariably, when the two pole faces meet, there will be an appreciable degree of overlap involving 80% of each face or more. Seldom will there be an overhang of more than 20%. In the present instance and with the structure illustrated in FIG. 7, the degree of overlap will be materially increased while the degree of overhang will be reduced to a minimum. In practically every instance where one of the parts 12 or 14, suspended from its respective key chain, is brought into proximity with the other part, the mutual attraction between the parts will be such that the part which is free to move will swing toward the other part and become centered thereon with the two magnets 32 and 62 substantially aligned and with any degree of overlap which may occur being so small that the forward end of the magnet will enter the rim 52 of the pole cup 30 and allow the former to seat squarely against the forward side of the lateral flange 67 with the two parts 12 and 14 becoming substantially centered. The relatively wide extent of the lateral flange 67 will permit the rim 52 of the pole cup 30 to seat thereagainst either in a centered relationship or in a slightly offset relationship. In either event, however, the forward end of the magnet will extend into the rim 52 and establish the lateral interlock between the two parts 12 and 14, as previously described. The difference in diameter between the magnet 62 and the cylindrical side wall 36 of the pole cup 30 is of such small magnitude that even the maximum possible degree of axial offset between the two parts 12 and 14 will not detract from the mutual attraction between the two parts.

In FIGS. 8, 9 and 10, a slightly modified form of the invention has been shown. The separable magnetic connector shown in these latter views is so similar to the connector shown in FIGS. 1 to 7, inclusive, that a detailed description thereof is unnecessary and it is deemed sufficient for an understanding of the modified form of the invention to apply similar reference numerals, but of a higher order, to the corresponding parts as between the structure of FIGS. 1 to 7, inclusive, and the structure of FIGS. 8, 9 and 10.

The connector 110 is comprised of two magnetic assemblies or parts 112 and 114, respectively. The part 112 is similar to the part 12, while the part 114 is similar to the part 14. Whereas, in the earlier described form of the invention the diameter of the bottom wall 34 of the pole cup 30 is substantially the same as the diameter of the bottom wall of the pole cup 60 so that when the two parts 12 and 14 are coaxially coupled, the two cylindrical side walls 36 and 66 are in circumferential register with the flange 67 projecting beyond and overhanging the rim 52, in the modified form of the invention, the diameter of the bottom wall 164 of the pole cup 160 is somewhat less than the diameter of the bottom wall 134 of the pole cup 130 and the side wall 166, instead of being cylindrical, is frusto-conical so that this latter wall slopes away from the outside cylindrical surface of the magnet 162. The diameter of the cylindrical wall 136 of the pole cup 130 is somewhat greater than the minimum diameter of the lateral annular flange 167 on the pole cup 160 so that when the parts 112 and 114 are coaxially coupled, the rim 152 seats against the flange 167 and establishes a circular line contact therewith which is midway between the inner and the outer peripheries of the flange. As in the case in connection with the earlier described form of the invention, the magnet 32 is recessed in the cup 130, while the magnet 162 protrudes from the cup 160, the purpose and function of such recessing and protrusion being the same in both instances.

It is to be noted that by reason of the slope or flare of the frusto-conical side wall 136, there is an appreciable air gap between the side surface of the magnet and the side wall near the outer extremity of the latter and in which there is a concentration of magnetic flux. For this reason, the magnet assembly of FIG. 10 possesses unusual centering features wherein, when the two parts 130 and 160 are brought into close proximity with each other, the part 130 will tend to become centered on the part 160 with the two magnets 132 and 162 in substantial axial alignment.

Another point of difference between the two illustrated forms of the invention resides in the insertion into the narrow annular space 154 which exists between the outside cylindrical surface of the magnet 132 and the inner surface of the side wall 136 of the ring 155. This ring is in the form of a cylindrical band which surrounds the magnet and substantially completely fills the air gap which normally exists between the magnet and the pole cup. The outer rim of the band terminates flush with the rim 152 of the cylindrical side wall 136. The ring 155 is formed of a nonmagnetic material, such as aluminum or brass, and may be press-fitted within the annular space 154. The ring serves the dual function of preventing lateral shifting of the magnet 132 within its respective pole cup 130, and also serves to fill the space 154 and preclude the entrance of dirt, dust, or other foreign material into this space. Thus, despite the fact that the part 112 frequently is carried by the user in his pocket, foreign material, particularly magnetic particles which ordinarily would shunt the dielectric gap and impair the efficiency of the magnet insofar as its pulling power is concerned, is prevented from entering the annular space 154.

Otherwise, the separable magnetic connector 112 shown in FIGS. 8, 9, and 10 is substantially the same as the separable magnetic connector 12 shown in FIGS. 1 to 7, inclusive.

The invention is not to be limited to the exact arrangement of parts shown in the accompanying drawings or described in this specification as various changes in the details of construction may be resorted to without departing from the spirit of the invention. For example, while the invention has been shown and described as being employed as a key chain connector, the same is capable of many other uses. Separable magnetic connectors constructed according to the principles of the present invention are readily adaptable for use as refrigerator cabinet or other door latches. Another use which is contemplated is as a latch for trailer doors or doors on other moving

vehicles where looseness which may develop in the hinges would ordinarily lead to rattling or squeaking of the doors. The invention also is applicable to the construction of many articles of adornment or dress, jewelry or the like, such as separable belt buckles, wrist watch bands, bracelets, and clothing fasteners. In such instances, the mode of attachment of the two magnetic assemblies 12 or 112 and 14 or 114 to the articles to be separably fastened together may be varied without affecting the principal features of the invention. Therefore, only insofar as the invention has particularly been pointed out in the accompanying claims is the same to be limited.

Having thus described the invention what I claim as new and desire to secure by Letters Patent is:

1. A separable two-part magnetic connector comprising, in combination, first and second magnet assemblies; said first magnet assembly comprising a permanent magnet of the barium ferrite type and in the form of a flat circular disk presenting oppositely facing pole faces of opposite polarity and a narrow outer circular rim, and a pole cup of magnetic material and having a bottom wall and an outstanding marginal cylindrical side wall, presenting a circular rim, the magnet being nested within said pole cup and having one pole face thereof bonded to said bottom wall, the longitudinal extent of said cylindrical side wall being slightly greater than the thickness of the disk whereby the magnet is recessed within the pole cup so that its other pole face lies rearwardly of the outer rim of said side wall; said second magnet assembly comprising a permanent magnet of the barium ferrite type and in the form of a flat circular disk presenting oppositely facing pole faces of opposite polarity and a narrow outer circular rim, and a pole cup of magnetic material and having a bottom wall and an outstanding marginal cylindrical side wall presenting a circular rim, the magnet being nested within said pole cup and having one pole face thereof bonded to said bottom wall, the longitudinal extent of said outstanding side wall being slightly less than the thickness of the disk whereby the magnet projects outwardly and forwardly of the rim of said side wall; the rim of the side wall of the pole cup of the second magnet assembly being thicker in a radial direction than the rim of the side wall of the pole cup of the first magnet assembly, the mean diameter of the rim of the side wall of the pole cup of the first magnet assembly being greater than the inside diameter of the rim of the pole cup of the second magnet assembly and less than the outside diameter of such rim, and the diameter of the disk of the second magnet assembly being appreciably less than the inside diameter of the rim of the cylindrical side wall of the pole cup of the first magnet assembly so that when the two magnet assemblies are magnetically coupled substantially to the fullest extent of which they are capable, the pole cup of the first magnet assembly will be telescopically received over the projecting portion of the magnet of the second magnet assembly with the rim of the side wall thereof seated on and making line contact with the thicker rim of the side wall of the pole cup of the second magnet assembly, such seating of the rim being effective in various slight positions of axial misalignment between the two magnet assemblies.

2. A separable two-part magnetic connector as set forth in claim 1 and wherein the diameter of the disk of the first magnet assembly is less than the inside diameter of the side wall of the pole cup of the first magnet assembly so that a flux gap is created between the rim of such pole cup and magnet.

3. A separable two-part magnetic connector as set forth in claim 1 and wherein the diameter of the disk of the second magnet assembly is less than the inside diameter of the side wall of the pole cup of the second magnet assembly so that a flux gap is created between the rim of such pole cup and magnet.

4. A separable two-part magnetic connector as set forth in claim 1 and wherein the disk of each magnet assembly is less than the inside diameter of the surrounding side wall of its respective pole cup so that flux gaps are created between the rims of such side walls and their respective magnets.

5. A separable two-part magnetic connector as set forth in claim 1 and wherein the side walls of the pole cups of the first and second magnet assemblies respectively are cylindrical.

6. A separable two-part magnetic connector comprising, in combination, first and second magnet assemblies; said first magnet assembly comprising a permanent magnet of the barium ferrite type and in the form of a flat cricular disk presenting oppositely facing pole faces of opposite polarity and a narrow outer circular rim, and a pole cup of magnetic material and having a bottom wall and a forwardly and outwardly flared frusto-conical side wall, the magnet being nested within said pole cup and having one pole face thereof bonded to said bottom wall, the longitudinal extent of said cylindrical side wall being slightly greater than the thickness of the disk whereby the magnet is recessed within the pole cup so that its other pole face lies rearwardly of the outer rim of said side wall; said second magnet assembly comprising a permanent magnet of the barium ferrite type and in the form of a flat circular disk presenting oppositely facing pole faces of opposite polarity and a narrow outer circular rim, and a pole cup of magnetic material and having a bottom wall and a cylindrical side wall, the magnet being nested within said pole cup and having one pole face thereof bonded to said bottom wall, the longitudinal extent of said outstanding side wall being slightly less than the thickness of the disk whereby the magnet projects outwardly and forwardly of the rim of said side wall; the rim of the side wall of the pole cup of the second magnet assembly being thicker in a radial direction than the rim of the side wall of the pole cup of the first magnet assembly, the mean diameter of the rim of the side wall of the pole cup of the first magnet assembly being greater than the inside diameter of the rim of the pole cup of the second magnet assembly and less than the outside diameter of such rim, and the diameter of the disk of the second magnet assembly being appreciably less than the inside diameter of the rim of the cylindrical side wall of the pole cup of the first magnet assembly so that when the two magnet assemblies are magnetically coupled substantially to the fullest extent of which they are capable, the pole cup of the first magnet assembly will be telescopically received over the projecting portion of the magnet of the second magnet assembly with the rim of the side wall thereof seated on and making line contact with the thicker rim of the side wall of the pole cup of the second magnet assembly, such seating of the rim being effective in various slight positions of axial misalignment between the two magnet assemblies.

7. A separable two-part magnetic connector as set forth in claim 6 including, additionally, a ring of nonmagnetic material surrounding the magnet of the second magnet assembly and filling the flux gap associated therewith.

8. A separable two-part magnetic connector comprising, in combination, first and second magnet assemblies; said first magnet assembly comprising a permanent magnet of the barium ferrite type and in the form of a flat disk presenting oppositely facing pole faces of opposite polarity, and a pole cup of magnetic material and having a bottom wall and an outstanding marginal side wall presenting a continuous outer rim, the magnet being nested within said pole cup and having one pole face thereof bonded to said bottom wall, the longitudinal extent of said side wall being slightly greater than the thickness of the disk whereby the magnet is recessed within the pole cup so that its other pole face lies rearwardly of the outer rim of said side wall; said second magnet assembly comprising a permanent magnet of the barium ferrite type and in the form of a flat disk presenting oppositely facing pole faces of opposite polarity, and a pole cup of mag-

netic material and having a bottom wall and an outstanding marginal side wall presenting a continuous outer rim, the magnet being nested within said pole cup and having one pole face thereof bonded to said bottom wall, the longitudinal extent of said outstanding side wall being slightly less than the thickness of the disk whereby the magnet projects outwardly and forwardly of the rim of said side wall; the rim of the side wall of the pole cup of the second magnet being thicker than the rim of the side wall of the pole cup of the first magnet assembly, and the contour of the two rims being such that when the two magnet assemblies are magnetically coupled to the fullest extent of which they are capable, the pole cup of the first magnet assembly will be telescopically received over the projecting portion of the magnet of the second magnet assembly with the rim of the side wall thereof

seated on and making an area contact with the thicker rim of the side wall of the pole cup of the second magnet assembly and lying wholly within the confines of said thicker rim, such seating of the rim being effective in various slight positions of axial misalignment between the two magnet assemblies.

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