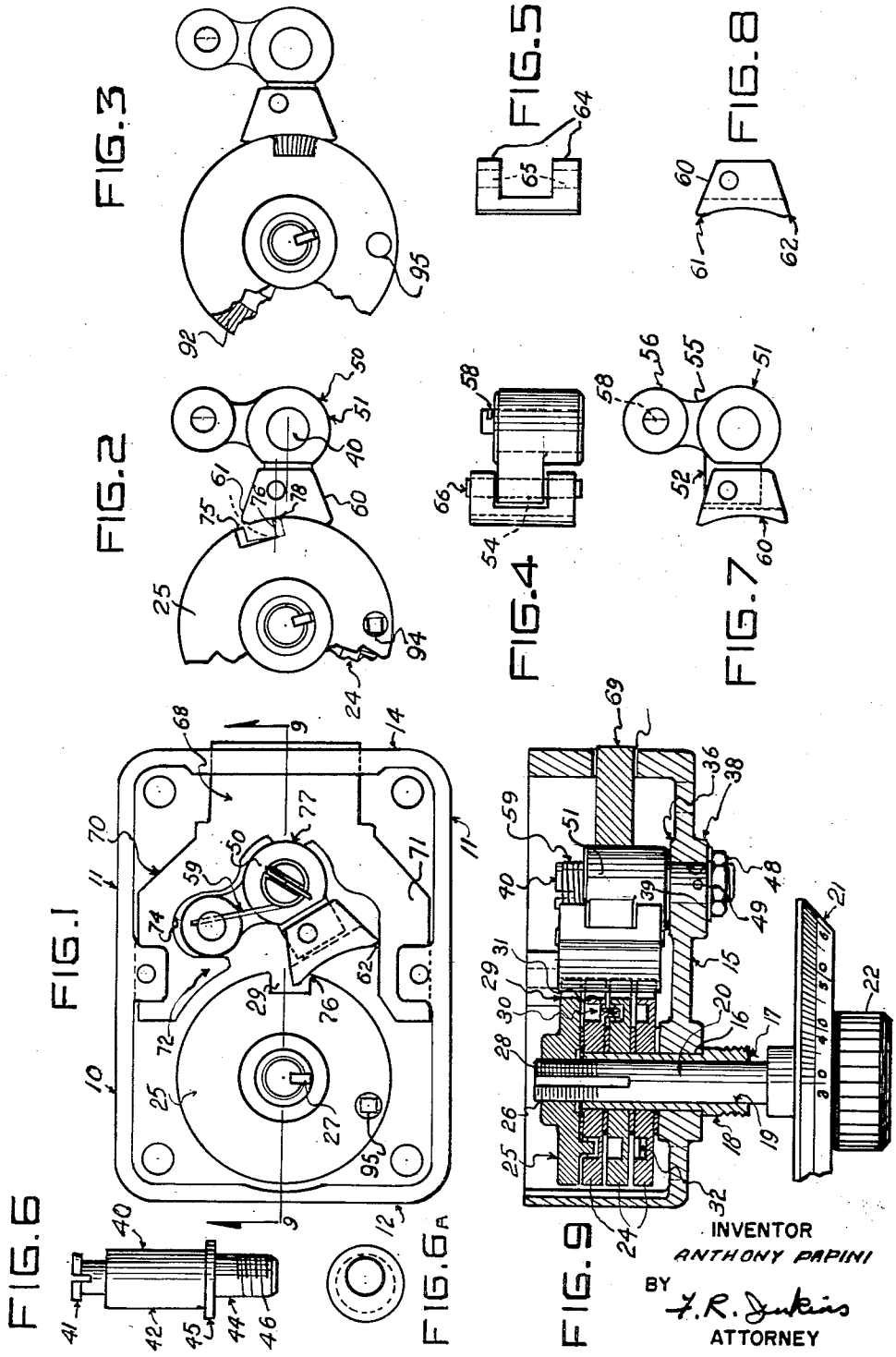
May 27, 1958 A. PAPINI 2,836,049

PIVOTED SHOE FENCE COMBINATION LOCK

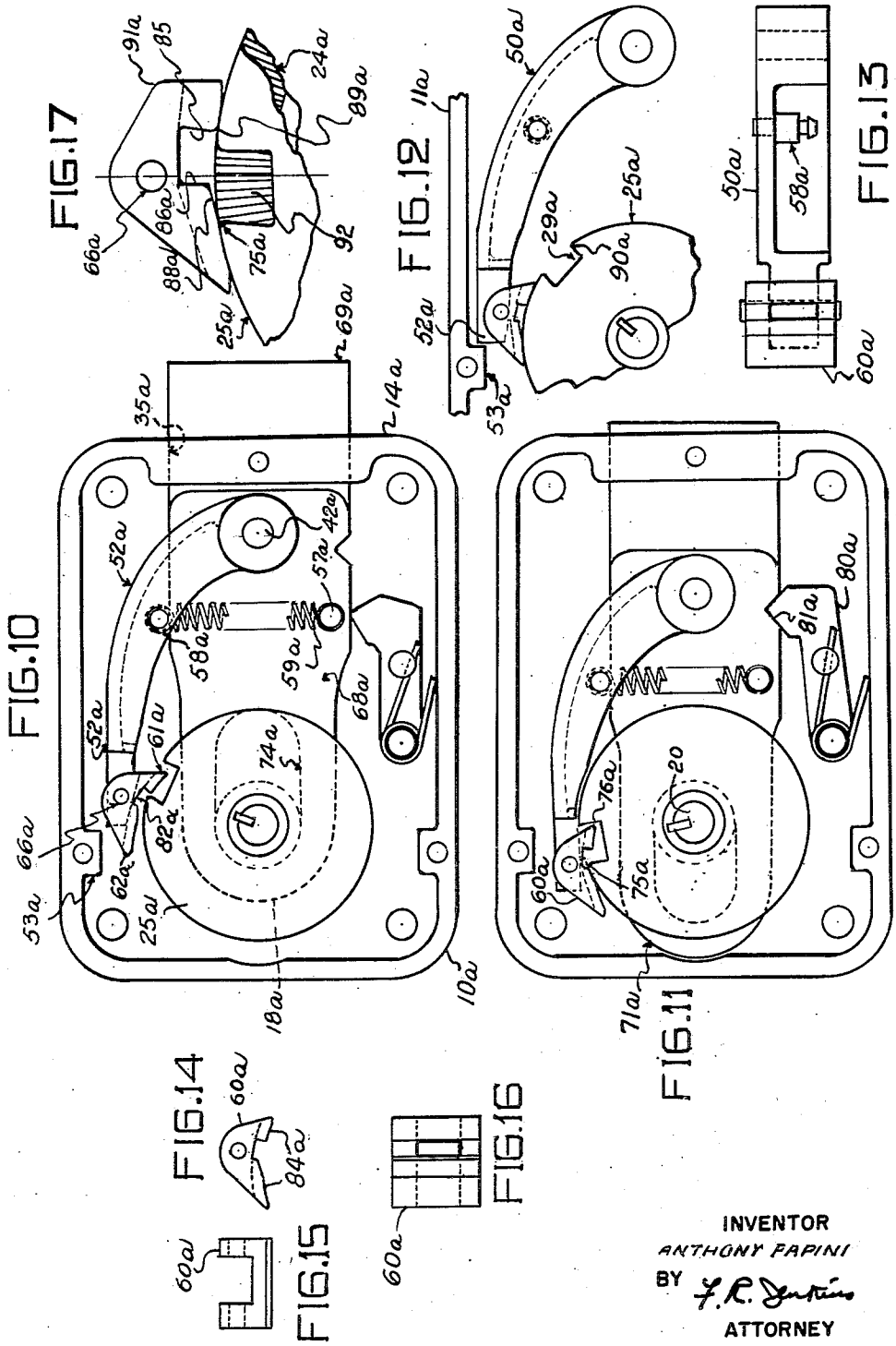
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PIVOTED SHOE FENCE COMBINATION LOCK

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PIVOTED SHOE FENCE COMBINATION LOCK

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4 Claims. (Cl. 70—133)

This invention relates to permutation or combination locks and more particularly to improved fences and associated mechanisms therefor.

One object of the invention is to provide a simplified fence mechanism that will produce no indication of tumbler-gate positions except at bolt retracting position.

Another object is to provide a simplified fence mechanism which may be used with conventional lock cases and tumbler systems with a minimum of alteration of stock parts.

Still another object is to provide a fence which cooperates with the lock tumblers to throw the lock bolt to locked position by turning the lock dial.

Yet another object is to provide a fence mechanism to automatically retract the bolt when the proper combination of tumbler positions is attained.

The attainment of these and other objects is reached in connection with a combination lock having a plurality of tumblers having alinable gates upon which tumblers a fence in the form of a pivoted shoe normally engages, said fence having an engagement distance with the tumblers greater than the width of the gates. When the gates are alined, the fence pivots on an axis parallel with that of the tumblers, and on the alined edges of the tumblers, to permit a side of the fence shoe to enter the gates. The entry of the fence into the gates allows the bolt to be drawn.

In the accompanying drawing showing, by way of example, two of many possible embodiments of the invention,

Fig. 1 is a rear view of one form of the lock, parts having been removed to show the interior;

Fig. 2 is a fragmental rear view showing the tumblers with gates almost alined with the shoe almost ready to enter therein;

Fig. 3 is a view similar to Fig. 2 with the shoe fence engaging on the periphery of a tumbler and spanning the gate therein;

Fig. 4 is a side view of the shoe and a member for controlling the position of the bolt;

Fig. 5 is a side view of the fence shoe;

Figs. 6 and 6*a* are, respectively, side and bottom views of a post for mounting the parts of Fig. 4;

Fig. 7 is a plan of the parts of Fig. 4;

Fig. 8 is an end view of the fence shoe;

Fig. 9 is a sectional view of the lock the section being taken substantially along the line 9—9 of Fig. 1 looking in the direction of the arrows of said line;

Fig. 10 is a view similar to that of Fig. 1 showing another form of the invention with the bolt in thrown position;

Fig. 11 shows the view of Fig. 10 with the bolt in drawn position;

Fig. 12 shows the position of the shoe of Fig. 10 when the bolt is in locked position;

Fig. 13 shows a plan of parts in Fig. 12;

Figs. 14, 15 and 16 are, respectively, end, side and bottom views of the shoe of Fig. 10, and

Fig. 17 shows details of engagement of the shoe on the tumblers.

One form of the combination lock comprises a case **10** having side walls **11**, end walls **12** and **14** and a front wall **15**, the latter having a hole **16** therethrough. A tubular post **18** having a cylindrical bore **19** is force-fitted in the hole and projects into the interior of the case and is provided with a shoulder part **17** at its outer end. A spindle **20** is rotatably disposed in the bore of the tube coaxial therewith, the outer end portion of the spindle being provided with a dial **21** and operating knob **22**.

A plurality of driven disk-shaped tumblers **24** having central bearing holes therethrough are disposed on the tubular post and rotatable thereabout. The driven tumblers are of conventional type and are not described or shown in detail. The tumblers are ultimately driven by a substantially disk-shaped cam tumbler **25** secured fast, as by threads **26** and a key **27**, on the inner end portion **28** of the spindle concentric therewith over the inner end of the post. The cam **25** and driven tumblers **24** are circular and of the same diameter and have alinable gates **29** in their respective peripheral portions, each driven tumbler being provided with a circular groove **30** in the rear face thereof and open toward the cam, and with a projection **32** in each groove projected toward the cam. The carrier **31** on the front face of the cam, and of each tumbler, save the frontmost, projects into the groove of the adjacent tumbler for engaging the projection of the adjacent tumbler so that the tumblers may be successively set to aline their gates.

Spacers are disposed about the post between the cam and the tumbler, and between successive tumblers and a washer between the frontmost tumbler and the wall **15**.

The case end wall **14** is provided with a bolt opening **35**. The front wall **15** is provided with interior and exterior bosses **36** and **38** generally between said spindle and bolt opening, having a round hole **39** through the bosses and the wall substantially axially parallel with the spindle. A fence post **40** in the hole **39** is provided with an inner slotted flanged head **41**, a medial cylindrical bearing portion **42**, an axially offset cylindrical portion **44** toward the outer end, and an outstanding flange **45** intermediate the bearing portion and the offset portion, said offset portion being disposed in the round hole **39** and provided with post threads **46** at the outer end thereof for engaging a nut **48** engaging the outer boss **38** for mounting the fence post on the case. A pin **49** in the boss **38** and fence post prevents rotation thereof from a set position.

A generally L-shaped fence body **50** having a hub part **51** in the corner portion thereof is mounted with the hub part on the bearing portion **42** of the fence post for oscillation about the fence post.

One arm **52**, sometimes called a rear arm, of the fence body normally projects toward the spindle and is provided with a pivot bore **54** axially parallel with the spindle and fence post, the other arm **55** of the fence body having a bolt-engagement lug **56** having a slot **58** in a plane transverse to the fence post axis. A torsional spring **59** about the fence post head and having an end thereon (fast on the slotted head) and another end in the slot **58** is provided for biasing the fence body to turn about the fence post. A shoe **60** carried by the arm **52** is associated with said tumblers and cam and normally engages all of same at the peripheries thereof. The engagement surface of the shoe extends sufficiently with respect to the gate width so that the shoe may span the gate while engaging the peripheral portions of the tumbler on opposite sides of the gate simultaneously (see Fig. 3). The shoe has beveled or rounded edges as at **61** and **62** and has spaced end ears **64** provided with coaxial bearing openings **65**. Said one arm **52** is between said ears and

the shoe is pivoted for slight movement on the arm by a pivot pin **66** passing through the ear openings **65** and said bearing bore **54**. The axis of the pivot pin **66** is parallel with those of the fence post and spindle and preferably normally slightly out of the plane thereof in a direction opposite that in which the pin is biased to move so that the pin is biased by the spring to approach the spindle. A bolt member **68** of somewhat Y shape and in the case of has a keeper engaging shank **69** passing through the end case wall opening **35**. The bolt member has lateral arms **70** and **71** embracing at least parts of the fence body and engaging the side walls **11**, the arm **70** of the bolt member, adjacent the lug, being provided with an inwardly projecting portion **72** forming a slot **74** receiving the lug so that turning of the lug about the fence post will throw or draw the bolt member.

In operation, the cam tumbler **25** is manipulated by the knob in the usual manner until all the driven tumblers have their gates **29** alined in the same position. Before their alinement, the gates of the driven tumblers may have almost any position even though the cam tumbler itself might be in the desired position.

It will be realized that the cam tumbler is primarily a driving means for the driven tumblers **24**, but because of the nature of the invention, it may be of the same diameter as the driven tumblers and so it is provided with its own gate to increase the number of permutations.

After the gates in the driven tumblers are alined in their proper position the fence action can be considered with reference to only the cam and one other tumbler. This action is described in connection with Fig. 2. The shoe is there shown in position on the drum of driven tumblers **24** ready for the trailing edge **61** to turn into their gates clearing the drum tumbler gate corners **75**. However the cam tumbler (top or covering tumbler in the drawing), having its gate forward corner edge **76** up against the shoe at a point (or line) **78** in advance of the center line joining the spindle and fence post, prevents any rotation about the fence post. As the cam corner edge **76** approaches the center line, the shoe still riding on the cam tumbler, the edge tends to become a fulcrum on which the shoe may turn, as well as about members **40** and **66**, so that the shoe edge **61** finally falls into the gate. The turning on such a fulcrum is facilitated since the shoe may also pivot about the pin in the arc shown within the gates. Having the shoe so pivoted greatly reduces the need for accuracy of construction and enables the lock to be produced cheaply, even though the gates must be accurately positioned for unlocking position. After the trailing edge **61** first begins to enter the gate the spring **59** turns the fence body about the fence post. The lug **56**, engaging the projection **72** on the bolt member, draws the member to retracted position as shown in Fig. 1, the drum of tumblers turning to follow the shoe through a few degrees. A stop **77** in the crotch of the bolt member engages against the hub portion **51** of the fence body to hold the bolt member in a definite position of retraction.

To throw the bolt, the knob **22** is turned backwardly from the direction just described. It is therefore desirable to limit movement of the shoe so that it cannot leave the gate when the bolt is retracted. This limitation is obtained when the shoe edge **62** strikes the yoke arm **71** as in Fig. 1.

The reason the trailing edge is beveled or rounded is to allow for inaccuracies in diameter of the tumblers, any looseness in the pivoting of the shoe, and the like which might cause the shoe to slightly turn into a gate before the combination of gate alinements is set and such a turning be detectedby an unauthorized person who could then, from a knowledge of the construction of the lock, determine how to bring such a gate into position for unlocking. By having the shoe edge beveled or rounded no detectable movement or noise is produced since the movement of the shoe edge would be gradual both into and out of the gate.

It will be noticed in Figs. 2 and 3 that each plane common with the drum axis and the pin **66** axis, or the post **40** axis; passes between the outer edges of the shoe.

As described, the fence post is preferably eccentric to facilitate assembly and location of the fence body and normal shoe position with respect to the tumblers and compensate for inaccuracies of manufacture. When a satisfactory assembly has been determined the post is then made fast by the fix pin **49**.

Those skilled in the art will know that materials must be chosen with due regard to wear and friction. Steel for all the tumblers and hardened steel for the shoe are satisfactory.

I have found by making a sample of the invention that the lock as shown can easily be built to require great accuracy in the dial settings. That is to say, the difference between gate width and the distance from the mentioned fulcruming position to the edge of the shoe may be made quite small.

Ordinary conventional details of construction may be employed. For example the tumblers may be provided with holes and combination changing means as at **94, 95**. Lugs on the side wall rear portion are provided with hole for the attachment of a cover.

While Figs. 1–9 show an embodiment of the invention wherein the chord of the arc **61—62** of the shoe is normally perpendicular to the direction of travel of the bolt the invention may be of such form that the chord is approximately parallel with said direction. Such a form is shown in Figs. 10–16. Generally, the latter form is preferable when the lock is to be of large size and the throw of the bolt greater, for, as described below, the shoe also acts as a dog engaging the cam gate to move the bolt more in the same direction as that of the cam gate than in Figs. 1–9.

In the form of the invention of Figs. 10–16 the lock comprises a case **10*a*** having an end wall **14*a*** having an opening **35*a*** with an elongated bolt **68*a*** having a keeper engaging forward end portion **69*a*** projecting through the opening **35*a***, the bolt being mounted for projective and retractive motion with respect to the case.

The rear portion **71*a*** of the bolt is provided with a longitudinal slot **74*a***, and a post **18*a***, similar to post **18** in Fig. 1, on the case and projecting into said slot prevents lateral movement of the bolt. A spindle such as **20** mounted in said post for rotary motion carries, as in Fig. 1, a plurality of disk shaped cooperating tumblers **24*a*** on the spindle for rotation about the axis of the spindle. The tumblers have alinable gates **29*a***, the innermost of said tumblers being a cam or cam tumbler **25*a*** and fast on the spindle, and all tumblers being of substantially the same diameter, as previously described.

In the cam tumbler, the gate is wider at its bottom than at its top to form a slightly acute angled nose **75*a*** at its margin, pointing forward in operative position.

For clarity, only the cam tumbler **25*a*** is shown in Figs. 10, 11 and 12, the driven tumblers **24*a*** appearing beneath it in Fig. 17.

A fence arm or link **50*a*** is pivotally mounted on the forward portion of the bolt as by a pin **42*a*** and has an end portion **52*a*** extending rearwardly to a position nearly tangential to the tumblers and constrained to move in a plane substantially parallel to those of the tumblers.

A fence in the form of a shoe **60*a*** normally rides on all the tumblers including the cam tumbler **25*a***, and is mounted by a pivot pin **66*a*** on said end portion of the link to permit the shoe to turn and allow the forward edge portion **61*a*** of the shoe to enter the gates when the latter are alined. Means such as a spring **59*a*** attached to the bolt and link at **57*a*** and **58*a*** urges the link to move with respect to the bolt and to urge the axis of the pin in a general direction toward the axis of the spindle.

When the shoe 60*a* rides on the peripheries of the tumblers, as in Fig. 12, it holds the end portion 52*a* of the link near a case side wall 11*a* having an internally projecting lug 53*a* which blocks rearward movement of the link and bolt from projective position. When the gates become alined at the predetermined position shown approximately in Fig. 10 and the cam is turned counterclockwise the shoe edge 61*a* turns about the pin 66*a* and gate nose 75*a*. This action permits the edge portion 61*a* to enter the gates and the link end portion 52*a* to move clear of the lug 53*a*. Continued counterclockwise motion of the cam 25*a* brings the opposite margin 76*a* of the gate against the shoe portion 61*a* and retracts the link and bolt to the position shown in Fig. 11. The bolt may be stopped by the rear end of the case. Detent means 80*a* engageable in a notch 81*a* in the bolt lightly holds the bolt in retracted position.

The throwing of the bolt 68*a* is not quite the same as that of bolt 68, since the travel of bolt 68*a* is much greater than the in-and-out motion of the pin 66*a*. In order for the nose 75*a* to bear sufficiently against the shoe 60*a* the latter is provided with a groove 82*a* in the arcuate face 84*a* of the shoe. I have found it desirable that the forward face 85 of the groove be slightly undercut or dovetailed for better engagement with the nose 75*a* so that the shoe is not expelled from the gate before the link has advanced to clear the lug 53*a*.

To insure that the shoe may turn, when entering into gates for unlocking, about the pin 66*a*, I have found it desirable that the arcuate face rear of the rear groove wall 86*a* be beveled as at 88*a*.

The forward edge portion 61*a* is rounded or beveled, as is rear edge portion 62*a* of the shoe and also the edge 89*a* at the juncture of the groove front wall 85*a* with the arcuate face. By having these edges and the gate noses 75*a* and 90*a* (Fig. 12) rounded or beveled, the shoe movement which might otherwise produce a click as a gate passes under may be made so gradual that no indication of the gate position is possible. The forward edge portion may be provided with a hump 91*a* (Fig. 17) to permit smoother entry and exit of the shoe into and out of the gate.

The shoe 60*a* normally, i. e. when the gates are not in predetermined alined position but a gate is wholly under the shoe, extends across a gate with the extreme outer, or forward and trailing edge portions of the shoe simultaneously engaging the periphery of the tumbler on opposite sides of the gate in question. Any losses of

full peripheral use of the tumblers due to the beveled or rounded edges are of little consequence since the invention of Figs. 10–16 is contemplated for large locks having large tumblers, although shoe 60*a* may be used in the lock of Figs. 1–9.

In both forms of the invention conventional tumblers may be used, having conventional refinements such as division marks 92 and means 94 for changing the combination with access holes 95.

The invention claimed is:

1. In a combination lock, an axle member; a plurality of tumbler disks having alinable gates in the peripheral portions thereof and rotatable about the axis of the member; a fence member having a shoe pivoted to turn about an axis parallel with that of the member, the shoe normally engaging all the disks at the peripheral portions thereof for a chordal distance greater than the width of the gates, the gates being wide enough so that, when they are alined, an edge portion of the shoe may turn about the second mentioned axis and enter into the gates when the latter are alined.

2. A lock comprising a case, and a plurality of coaxial tumbler disks mounted therein, the disks having alinable gates in the peripheral portions thereof; a shoe having an arcuate engagement face substantially coaxial with the disks and engaging same over a greater distance than the width of the gates; said shoe being turnable on the gate marginal portions of the disks to permit a part thereof to enter alined gates; a carrier for the shoe and pivotally mounted for turning about an axis parallel with that of the disks, and biasing means tending to turn the carrier about said axis for urging the shoe against the disk peripheries, and a bolt in operative engagement with the carrier.

3. A lock as claimed in claim 2 the carrier being pivotally mounted on the case.

4. A lock as claimed in claim 2 the carrier being pivotally mounted on the bolt.

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