Oct. 16, 1956 J. HAGEL 2,766,611

SLIDE TUMBLER SHELL PLUG CYLINDER LOCK

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Fig. 1a

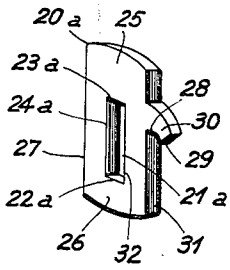


Fig. 1b

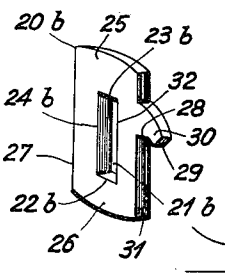


Fig. 1c

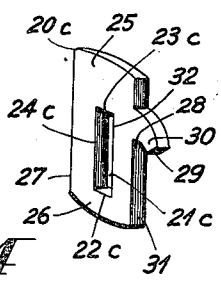


Fig. 4

Fig. 2

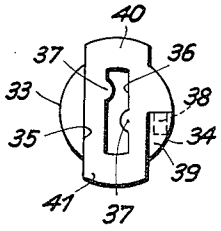
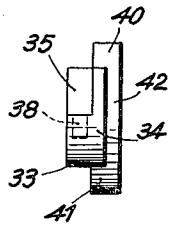


Fig. 3



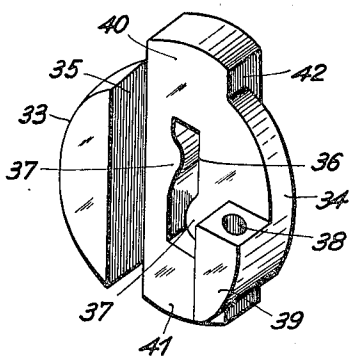


Fig. 5

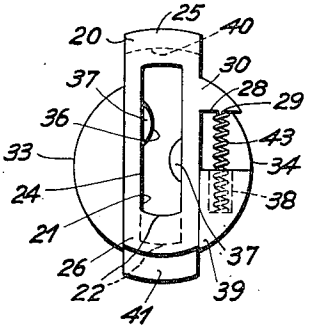
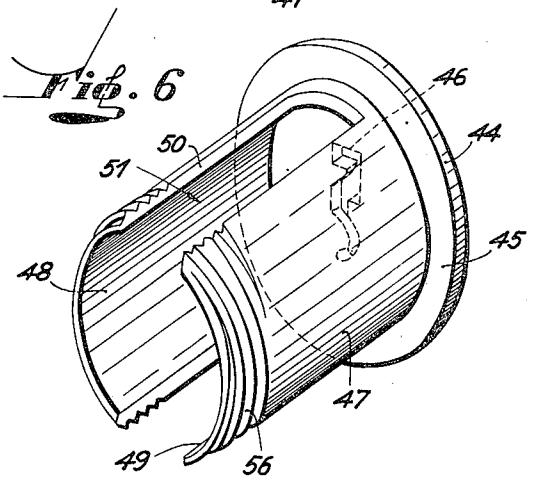


Fig. 6



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SLIDE TUMBLER SHELL PLUG CYLINDER LOCK

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Fig. 7

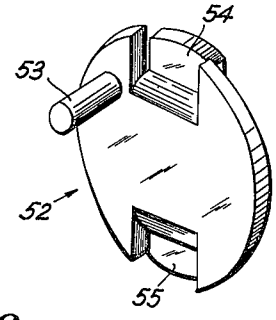


Fig. 8

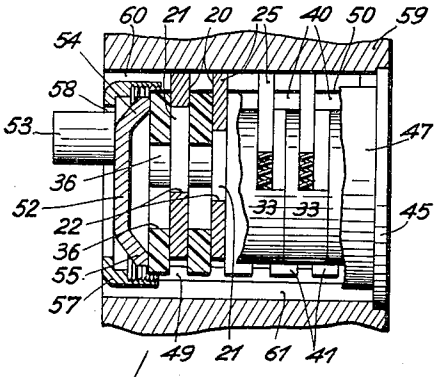


Fig. 9

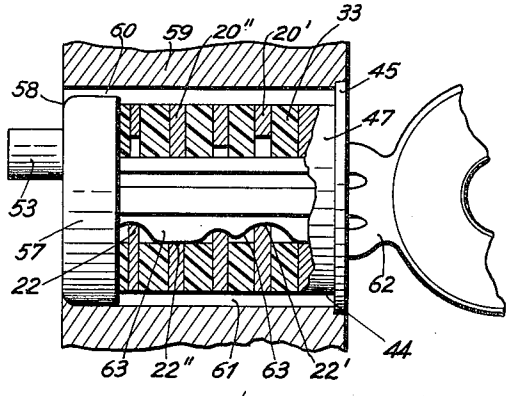


Fig. 10

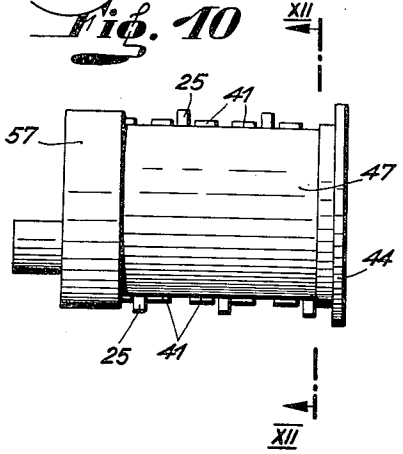
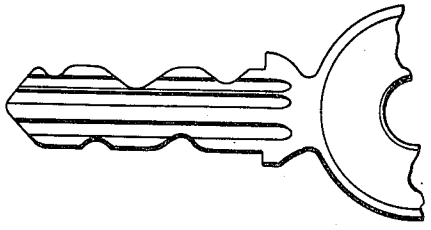


Fig. 11



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Fig. 12

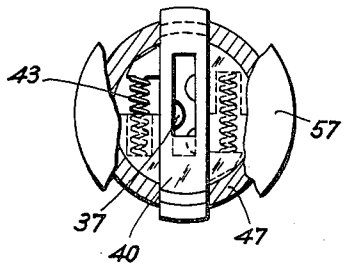


Fig. 13

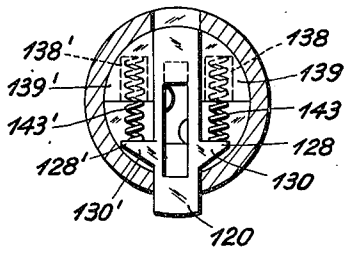


Fig. 14

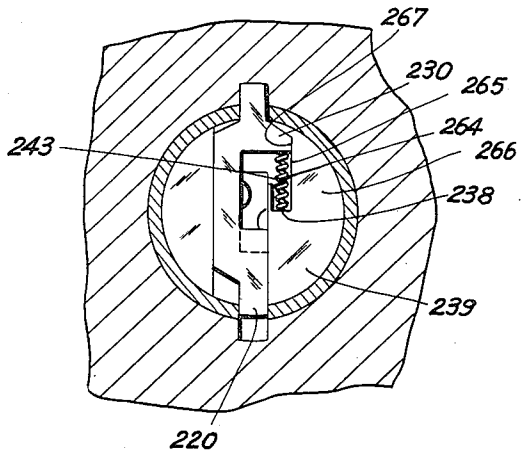
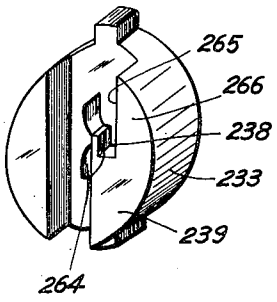


Fig. 15



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SLIDE TUMBLER SHELL PLUG CYLINDER LOCK

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Fig. 16

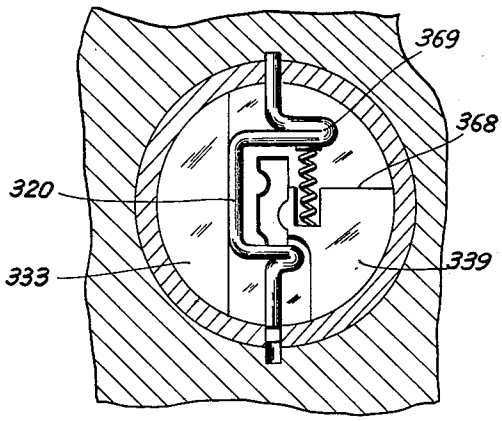


Fig. 17

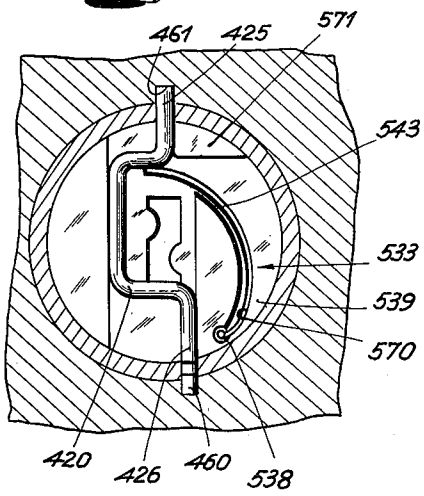


Fig. 18

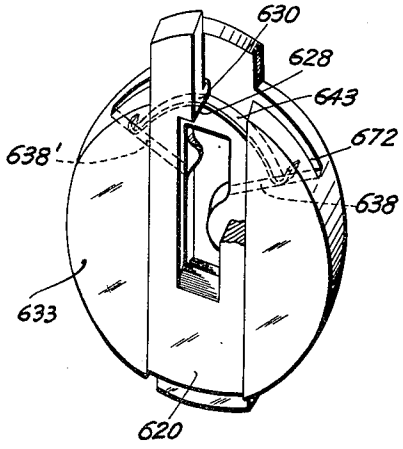


Fig. 19

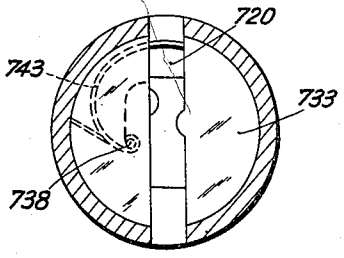
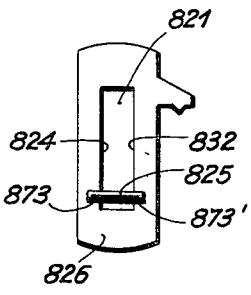


Fig. 20



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United States Patent Office 2,766,611 Patented Oct. 16, 1956

2,766,611

SLIDE TUMBLER SHELL PLUG CYLINDER LOCK

Jakob Hagel, Buenos Aires, Argentina, assignor to C. C. Mauthe Soc. En Com. Por Acciones, Buenos Aires, Argentina, a company of Buenos Aires, Argentina

Application August 4, 1952, Serial No. 302,535

10 Claims. (Cl. 70—364)

The present invention relates to the so-called cylinder locks which are really key operated mechanisms capable of being associated with a variety of lock mechanisms properly so called, as by means of a transmission device, such as a tongue projecting from the plug member of the cylinder lock into the lock mechanism proper.

The practically successful cylinder lock heretofore proposed has been of the pin tumbler type and is usually referred to as the Yale lock. While entirely satisfactory from the points of view of ready adaptability for a number of purposes, reliability of operation, security, number of possible key pattern changes, smallness and lightness of the key, nevertheless, in the course of manufacture, it calls for a number of operations some of which require a considerable amount of skill and others of which are troublesome and time consuming.

As is well known, a pin tumbler lock comprises a relatively fixed cylinder in which is rotatably mounted a plug provided with a longitudinal key passage, said plug being prevented from turning in the absence of the key, by the projection from the cylinder into the plug of a plurality of pins which are lifted by the insertion of the key, up to a level permitting rotation of the plug by the key. The pin tumblers are, of course, of different lengths and with them cooperate the serrations or teeth cut to various depths in the key. In order to keep the width of the key and the size of the lock as a whole within reasonable dimensions, the pin tumblers are usually subdivided and each tumbler thus comprises at least two principal parts, one being associated more particularly with the plug and the other with the cylinder, spring means being provided in back of the cylinder pin portion to urge the composite pin tumbler into the plug. Thus the key need raise the tumblers only through the height necessary to bring the line of junction of the two pin portions into alinement with the interface between the plug and the cylinder.

It will be clear to those skilled in the art from the above brief summary, that in the construction of the known pin tumbler cylinder locks it is necessary, after assembly of the blank plug and cylinder, to drill into the assembly radially a plurality of holes spaced along a generatrix and extending into the key way, to hold the plug in position in the cylinder while the pin tumblers and springs are inserted into the corresponding holes, and afterwards to plug the ends of the holes lying on the surface of the cylinder. To provide screw plugs for closing up the outer ends of the holes would make the lock far too expensive, so that the pin tumbler cylinder locks known in commerce must be considered as immutable as regards the pin tumbler combination they contain, when they leave the factory.

It will be seen, therefore, that not only does the making of a pin tumbler lock of the "Yale" type call for a certain amount of skill, but it likewise is time consuming, particularly in the assembly operations. Moreover, for proper guidance of the pin portions, it is requisite that the plug be made out of the solid, and this in turn involves

machining the key-way, and accurate fitting of the plug in the cylinder, which must also be bored lengthwise to receive the plug.

Designed for use with a particular type of lock mechanism, another kind of cylinder lock known as the Kromer lock, has also been heretofore proposed, which cylinder lock comprises plate tumblers as the locking elements, said plate tumblers being housed in a hollow plug member having diametrically opposite, relatively wide, longitudinal slots adapted to be alined with similar slots in the outer cylinder. The plate tumblers are deeply recessed to define shaped recesses which are symmetrically disposed. The end plate of the cylinder has a key hole, and the key is of the barrel type with sectorial bits extending from diametrically opposite parts of the barrel. In the locked position the plate tumblers extend alternately on opposite sides into the cylinder slots and thus prevent turning of the hollow plug. On insertion of the key, the same must first be turned a little in one direction to retract the tumblers from locking position, and thereupon turning of the key in the opposite direction causes rotation of the hollow plug relatively to the cylinder, whereby, through intermediate instrumentalities, the actual bolt of the lock mechanism proper is freed for manual operation.

For the plate tumbler cylinder lock just described, the key, by the very nature of the case, has to be somewhat bulky, and it would be impossible to secure with such a lock, the advantages of the small flat key as used in the pin tumbler type of lock.

In view of the abovementioned constructional and manufacturing difficulties, the present invention has for ts principal object to provide a novel type of cylinder lock, herein designated as slide tumbler shell plug cylinder lock, or more briefly slide tumbler cylinder lock, so constructed that the principal, and indeed substantially all of the component parts thereof may be made by stamping and/or molding, and that the assembly thereof may be effected by a simple additive process, that is to say, by simply bringing the stampings and moldings together without requiring any additional or subsequent machining or the like operations.

A further object of the present invention is to provide a novel type of cylinder lock in which the tumblers shall be stampings or pressings in the form of slides, that is to say members having appreciable extension in each of two dimensions defining a plane, as distinguished from pins, which, by comparison have appreciable extension in only one of such pair of directions.

A further object of the invention is to provide a cylinder lock having spring urged tumblers housed in a shell constituting the plug member of the lock.

Another object of the invention is to provide a cylinder lock of the type described in which the coupling member for coupling the cylinder lock mechanism to a lock mechanism proper shall be of simple construction and shall consist principally of a stamping.

Yet another object of the present invention is to provide a slide tumbler cylinder lock in which it shall be essentially possible to alter the relative positions of the slide tumblers and, if required, to substitute replacement or new tumblers for worn or existing ones, by a simple process of disassembly and reassembly.

Another object of the present invention is to provide for use in combination with a controlled lock mechanism, a slide tumbler cylinder lock operable by a flat key, in which said key shall be insertable in said cylinder lock in either the position corresponding to locked position of the controlled lock mechanism or in the position corresponding to open position of said controlled lock mechanism, and shall be withdrawable from said cylinder lock,

upon unidirectional rotation of the plug thereof from the position of insertion to the other of said two positions.

Another object of the present invention is to provide a slide tumbler cylinder lock so constructed that at least one of said tumblers may readily be made of hardened steel or the like drill resisting materials, whereby breaking of the lock by cutting away the tumblers shall be materially prevented.

A still further object of the present invention is to provide a slide tumbler cylinder lock in which the tumblers may be made, as by pressing, of shaped wire, such as steel wire.

A further object of the invention is to provide a slide tumbler cylinder lock in which some of the tumblers may be inverted with respect to the remainder, entailing the use of a double-bitted flat key, whereby the number of combinations, that is to say, the number of different possible keys, is greatly increased.

Yet another object of the invention is to provide a slide tumbler cylinder lock in which the tumblers may be fitted with rotary rollers to diminish the wear on the key teeth or notches.

Another object of the invention is to provide a slide tumbler cylinder lock in which it shall be possible, as desired, to use either coil or leaf springs as the resilient elements urging said tumblers to locked position.

Another object of the present invention is to provide a slide tumbler cylinder lock comprising molded or pressed guide members for the tumblers, and said guide members may be made of non-metallic materials, such as plastics.

These and other objects and advantages of the present invention will become more clearly apparent in the course of the detailed description of the accompanying drawings which illustrate by way of example certain preferred embodiments of my invention.

In the drawings:

Figs. 1*a*, 1*b* and 1*c* are perspective views illustrating slide tumblers suitable for use in the cylinder lock of the present invention.

Fig. 2 is a front elevation of a guide member for use with a slide tumbler of the kind shown in Figs. 1*a*, 1*b* and 1*c*.

Fig. 3 is a side elevation of the guide member of Fig. 2.

Fig. 4 is a perspective view on an enlarged scale of the guide member shown in Figs. 2 and 3.

Fig. 5 is a front elevation of an assembly of slide tumbler and guide member together with the spring urging means.

Fig. 6 is a perspective view of a shell plug as used in the cylinder lock of the present invention.

Fig. 7 is a perspective view of a coupling or motion transfer plate for coupling the slide tumbler cylinder lock to a lock mechanism proper.

Fig. 8 is a side view partly in section of a slide tumbler cylinder lock according to the present invention built up of parts as shown in Figs. 5, 6 and 7, said lock being shown in locked position.

Fig. 9 is a view similiar to that of Fig. 8 showing the lock in open position on the insertion of the key.

Fig. 10 is a side view of a cylinder lock similar to that of Figs. 8 and 9, but with some of the slide tumblers inverted with respect to the others.

Fig. 11 is a side view of a key suitable for use with the lock of Fig. 10.

Fig. 12 is a section along the line XII—XII of Fig. 10.

Fig. 13 is a cross section of the shell plug of a lock according to the present invention, illustrating a modified form of slide tumbler.

Fig. 14 is a cross section of a cylinder lock according to the present invention, illustrating modified forms of slide tumbler and guide.

Fig. 15 is a perspective view of the modified guide member of Fig. 14.

Fig. 16 is a cross section of a cylinder lock according to the present invention, illustrating one form of slide tumbler made of wire.

Fig. 17 is a cross section similar to that of Fig. 16 but illustrating the use of a still further modified form of wire slide tumbler and the employment of leaf spring urging or restoring means.

Fig. 18 is a perspective view of a slide tumbler and guide assembly illustrating a further modification of a leaf spring controlled embodiment.

Fig. 19 is an elevation partly in section showing another variant of the leaf spring controlled embodiment, and

Fig. 20 is a front elevation of a slide tumbler fitted with an anti-friction roller.

Considering first Figs. 1*a* through 9, I have illustrated in Figs. 1*a*, 1*b* and 1*c* slide tumblers **20***a*, **20***b* and **20***c* suitable for use in a shell plug cylinder lock of the present invention, which represent one embodiment thereof comprising all the essential functional parts of such tumblers.

As here shown, said tumblers are produced, as by stamping, from strip metal of a suitable thickness, such as one or two millimeters, to comprise a gate aperture **21***a*, **21***b*, **21***c*, defined by a gate edge **22***a*, **22***b*, **22***c* a limit edge **23***a*, **23***b*, **23***c* and at least one side edge **24***a*, **24***b*, **24***c* extending from the respective gate edge to the corresponding limit edge. Said tumblers likewise comprise a locking portion **25** located on the side of the limit edge remote from the gate edge, and a tail or guide portion **26** located on the side of the gate edge remote from the limit edge. The tumblers are adapted to be guided for sliding movement lengthwise of themselves and to be returned automatically to a normal or locking position in the assembled lock, as will hereinafter be explained, and to this end include at least one guide edge, such as the edge **27** located adjacent and parallel to the respective side edge **24***a*, **24***b*, **24***c*, and defining a part of the outer contour of the tumbler. Each tumbler likewise has a spring seat, shown in the embodiment of Figs. 1*a*, 1*b* and 1*c*, as defined by a lower straight edge **28** including a spring centering pip **29** of an arm **30** projecting laterally from the bounding edge **31** opposite and parallel to the guide edge **27**. Preferably the free ends of the locking portion **25** and the tail portion **26** are rounded or arcuate in the plane of the tumbler and the free gate edge **22** is rounded transversely of said plane.

As illustrated in Figs. 1*a*, 1*b* and 1*c*, the gate apertures have been cut in the central portions of the tumbler plates and are therefore further defined by an inner edge **32** parallel to the side edge **24***a*, **24***b*, **24***c* of the respective tumblers, but it is to be understood that, as will hereinafter appear, said inner edge **32** may be absent. Comparison of Figs. 1*a*, 1*b*, and 1*c* will show that the gate apertures **21***a*, **21***b*, **21***c* are provided at different positions heightwise or lengthwise of the tumblers, so that when the tumblers are arranged in succession with the locking portions and the tail portions respectively in alinement, the gate edges **22***a*, **22***b*, **22***c* will form a series staggered heightwise of the tumblers. The height of the gate apertures must be at least equal to the maximum width of the key shank which is to be used with the lock for which the tumblers are designed.

For guiding the slide tumblers, I provide spacer members **33**, one form of which is illustrated in Figs. 2, 3 and 4. As there shown said spacer members comprise a substantially cylindrical body portion **34**, diametrically recessed on one end face to define a guide wall **35** and perforated in the axial direction to define a key-pass aperture **36** which may be and desirably is, provided with inwardly projecting ward members **37**, which, however may be provided in only some of the spacer members pertaining to a given lock assembly. With the exception of the presence or absence of ward projections, all of the spacer members of a set intended for a given lock are similar, even as to the location of the key-pass apertures, which will all be fully alined when the spacer members are arranged in coaxial alined succession. The dimensions of the key-pass apertures must be such as to allow

free passage of the widest and thickest portions of the key shank.

On the same side of the body portion **34** of the spacer member **33** as the guide wall **35**, I provide a spring seating. In the embodiment of Figs. 2 to 4, said seating is in the form of a bore **38** extending substantially parallel to the major dimension of the key-pass aperture **36** and made in a projecting ledge portion **39**, which may be considered as formed by cutting away a part of the body portion opposite said guide wall **35**.

The spacer members **33** also comprise upper and lower lugs **40**, **41**, for securing the spacer members against rotation when assembled in a lock.

In the embodiment shown in Figs. 2 to 4, the spacer members **33** have on the side thereof remote from the side from which the guide wall **35** extends, a diametrically extending ridge **42** in alinement with and merging into said upper and lower lugs **40** and **41**. In this construction, therefore, the depth of the recess defined by the guide wall **35** should be substantially equal to the thickness of a tumbler plus the thickness of the ridge **42**, measured axially of said spacer member, just sufficient play axially of the structure being provided in the assembled condition of the parts, so as to prevent binding of the tumblers against the faces of the spacer members forming the bottoms of the recesses defined by said guide walls **35**. Preferably the width of said recess between said guide wall **35** and said ledge portion **39** is substantially equal to the width of a slide tumbler, so that, as can be seen in Fig. 5, such tumbler may be guided on both sides, so as to prevent tilting thereof transversely of the spacer member **33**. Fig. 5 likewise shows a coil spring **43** seated between the bottom of the bore **38** and the seating edge **28** of the tumbler **20**, whereby said tumbler is normally urged to a locking position, in which the locking portion **25** thereof extends beyond the lug **40** of the spacer member **33**, and the gate edge **22** of said tumbler partially obstructs the key-pass aperture **36** of said spacer member. It may here be noted that although for convenience, the lugs **40** and **41** were referred to hereinabove as upper and lower lugs, when a slide tumbler cylinder lock of the present invention is installed, said lugs may be in any position within a full circular ambit, so that upper lug **40** may actually be in a lower position than lower lug **41**; in fact the positions of the lugs may be reversed. This amplitude of choice of position in which the lock may be fitted is rendered possible by the use of resilient means for urging the slide tumblers to locked position, whereby the possible effects of gravity are counteracted. It is to illustrate this feature that the tumbler and spacer assembly has been shown in Fig. 5 with the tumbler urged upwardly into locking position. As shown in said figure, the assembly calls for insertion of the key with the serrations directed downwardly, since it is the serrations which have to engage the gate edge **22** to retract the tumbler into free position, as will appear more clearly hereinafter.

Turning now to Figs. 6 and 7, I have therein shown the shell plug indicated by the general reference numeral **44**, which comprises an end plate **45** having a key hole **46**, and a pair of cylindrical segments **47**, **48** secured, as by brazing, to the end plate **45** and extending normally therefrom in spaced relation to define upper and lower longitudinal slots **50** and **49** of a width to receive the lugs **40** and **41** of the spacer members **33** and the locking and tail portions **25** and **26** of the slide tumblers **20**. Said spaced segments **47** and **48** define between them a cylindrical chamber **51** of internal diameter substantially equal to the diameter of said spacer members **33**.

The free end of the shell plug thus constituted, that is to say the end thereof remote from the end plate **45**, is adapted to receive a tongue plate indicated by the general reference character **52** in Fig. 7, said tongue plate being substantially a circular disc having a tongue pin

53 extending from one face thereof and a pair of diametrically opposite offset lugs **54**, **55** lying beyond the face of said disc remote from said tongue pin **53**. Conveniently said offset lugs lie in a plane parallel to but slightly spaced from said disc as clearly seen in Fig. 7 and are formed by a blanking and bending operation from the disc itself so that the overall distance between the free ends of said offset lugs is slightly less than the diameter of said disc. The disc or tongue plate **52** is of a size to fit against the free end of the shell plug, and the offset lugs are dimensioned to enter said slots **50** and **49** for the purpose of holding said tongue plate against rotation when the shell plug has been fully assembled with the tumblers and spacer members.

From the foregoing description of the essential component parts, it will be seen that all of them may be easily and cheaply produced and readily assembled. The tumblers may be manufactured by pressing or stamping; the spacer members **33**, which are preferable of non metallic material, may be molded; the shell of the plug may be pressed or stamped from sheet material or prepared from tubular material, the slots then being cut by a stamping operation; similarly the end plate **44** may be stamped from sheet material, and the tongue plate may be prepared in a similar manner. The only additional manufacturing steps before assembly would be to braze or otherwise unite the segments **49**, **50** to the end plate **44** and to fix the tongue pin, as by rivetting, to the tongue plate **52**, and to provide an end cap, to be more particularly described in connection with Figs. 8 and 9, and if necessary to provide a screw thread, such as the thread **56** (see Fig. 6) over a portion of the outer surface of the shell plug adjacent the free end thereof. The springs **43** may, of course, be produced and cut to size by any of the well known methods.

It will also be readily appreciated that the cylinder lock of the present invention may readily be assembled by merely sliding into the shell plug **44** unitary assemblies of slide tumbler, spacer member and spring, of the kind illustrated in Fig. 5. Such essemblies may be grasped between the thumb and a finger of the hand at the lugs **40**, **41**, thereby at the same time urging the slide tumbler inwardly of the spacer member so as to allow of easy entry, since in the disassembled condition, the outer edge of the arm **30** may, as shown in Fig. 5, extend slightly beyond the edge of the spacer member. Said unitary assemblies are introduced preferably with the tumbler leading, the first spacer member to be introduced being preferably one with wards. When a sufficient number of such unitary assemblies has been inserted, say for example five such assemblies, the tongue plate **52** is applied with the offset lugs **54**, **55** alined with the slots **50**, **49**, so as to enter said slots, and finally an annular end closure cap, such as the cap **57** (Figs. 9 and 10) is applied to the shell to hold the assembled parts together.

For cylinder locks to be used in combination with bolt locks in such circumstances as to render it desirable to be able to change the tumblers, the end closure cap may be removably secured to the shell plug, as by screwing, to which end the shell plug illustrated in Fig. 6 has been shown with a screw threaded portion **56**. When, however, the cylinder lock is intended to form part of a combination, such as a padlock, where the tumbler combination will usually not require to be changed or renewed, by reason of the value of the padlock as a whole and the use to which it is to be put, a plain annular end cap may be used and secured permanently in position as by spinning.

In Figs. 8 and 9 I have shown a slide tumbler cylinder lock assembly according to the present invention and made up of parts such as illustrated in Figs. 1*a* through 7, fitted for use, the connection between the tongue pin **53** to a lock mechanism proper having been omitted as

not being relevant to the present invention. As shown in Figs. 8 and 9, the shell plug **44** has been fitted into a cylindrical bore **58** in a relatively stationary member **59**, which may be a part of a lock casing, or an outer cylinder or a part of a door or the like, and is recessed at circumferentially spaced points in the example shown at diametrically opposite points, to provide upper and lower grooves **60**, **61** of a depth to receive the locking portions **25** and the tail portions **26** of the slide tumblers **20**. Fig. 8 shows the assembly in locked positions, and it will be noted that the locking portions **25** extend into the upper groove **60**, thereby preventing turning of the shell cylinder assembly relatively to the fixed member **59**. It will also be noted that whereas the key pass slots **36** are all in alinement axially of the assembly, the gate edges **22** are at different heights, so that the slide tumblers can be depressed all together to release the shell plug only if the proper key, having serrations suitably cut, is used. All of the slide tumblers must be depressed simultaneously to release the plug, as it will be apparent that so long as any one of said tumblers projects even though not fully, into the upper groove **60**, the shell plug cannot be turned.

Fig. 9 shows the assembly in released position ready for turning after the insertion of the proper key **62**, the serrations **63** of which are designed to depress all the slide tumblers when the key has been fully inserted. It will also be noted that although all of the tumblers have been retracted to lie within the shell plug, the gate edges **22** are at different heights. Thus the gate edge **22'** of tumbler **20'** is appreciably higher than the gate edge **22''** of tumbler **20''**. The latter tumbler is shown as depressed by one of the highest portions of the key **62**, and as the tumbler **20''** is on the side of tumbler **20'** remote from the key hole, said highest portion of the key will have to pass through the gate aperture of tumbler **20'** before reaching tumbler **20''**, thereby depressing tumbler **20'** beyond the final position thereof, whereby said tumbler **20'** is caused momentarily to have its tail portion project beyond the shell while said highest portion of the key is passing through the gate aperture of tumbler **20'**. Hence in fitting the shell plug to form part of an operative assembly, sufficient clearance must be provided to permit said momentary protrusion of the tail portions, for both the positions of the shell plug corresponding to locked and unlocked positions of the bolt lock proper with which said shell plug is associated. As shown in Figs. 8 and 9, the arrangement is such that the unlocked position of the bolt lock (not shown) corresponds to a position of the shell plug 180° from the position thereof in which said bolt lock is locked, so that the two grooves **60** and **61** provided to permit the locking portions of the slide tumblers **20** to protrude when the key is withdrawn, serve simultaneously to permit the outward movement of the tail portions. However, it may be desirable or necessary, for instance by reason of the design of the bolt lock with which the slide tumbler cylinder lock of the present invention is to cooperate, for the "bolt unlocked" position of the plug to be at less than 180° from the "bolt locked" position thereof, say at 90°. In that event, grooves such as the grooves **60** and **61** would have to be provided in the member into which the shell plug is fitted, but spaced apart 90°, and, substantially opposite these grooves, supplementary grooves must be provided to permit of the end play of the tail portions. Said supplementary grooves, however, as will hereinbelow appear, need not always be at 180° from the grooves for the locking portions.

It will be noted from the foregoing description of the construction and operation of the slide tumbler cylinder lock of the present invention that it requires only the provision of both the grooves **60** and **61** for the locking portions, in order to enable the key to be withdrawn from the shell plug assembly, both in the "bolt locked" and in the "bolt unlocked" positions, so that the rotary parts need not be brought back to initial position to enable the key to be withdrawn, as is the case both in the pin tumbler lock and the Kromer lock arrangements. At the same time, if the second groove **61** is not provided, my slide tumbler cylinder lock will act exactly like a pin tumbler lock, as far as the key operation is concerned, and may therefore be incorporated in such devices as night latches, without entailing any modification in the manner of using such devices. Evidently, such flexibility of adaptation, whereby the cylinder key mechanism may be utilized either for night latches or for devices of the ordinary door lock type, must be considered as a practical advantage of the present invention.

Referring now to Figs. 10, 11 and 12, I have therein illustrated another feature which the construction of the component parts of the slide tumbler cylinder lock of the present invention enables to be obtained. If during the assembly operation hereinabove described, alternate unitary tumbler and spacer assemblies are inserted into the shell plug upside down with respect to the others, the locking portions of such inverted assemblies will project from the shell on the opposite side as compared with the locking portions of the noninverted assemblies, as seen in Fig. 10. Moreover, as a consequence of the inversion of the unitary assemblies, the gate edges will also be inverted for alternate assemblies, so that the key for operating the cylinder lock will have to have serrations on both edges, as indicated in Fig. 11. Obviously, the inversion need not be made with alternate assemblies; any one or more such assemblies may be inverted, thereby alternating the key pattern on both edges, so that a considerable increase in the variety of key patterns, even for a reduced number of tumblers, is rendered possible.

The manner of assembling or rather the results of assembling the unitary assemblies in the way just described can readily be appreciated from Fig. 12.

Since the slide tumblers are made or can be made by stamping or pressing, it will readily be understood that they can be given a variety of shapes, and that the corresponding changes may readily be reflected in the spacer members, since these are adapted to be made by molding. Some of these variants have been illustrated in Figs. 13 to 20. Thus in the embodiment of Fig. 13, the slide tumbler **120**, has two lateral arms **130**, **130'** projecting from opposite sides of said tumbler to provide a pair of spring seats **128**, **128'** for a pair of springs **143**, **143'** for which also a pair of spring seatings or bores **138**, **138'** are provided, by replacing that part of the body portion **34** of the spacer member **33** shown in Fig. 4, which defines the full guide wall **35**, by a projecting ledge **139'** (Fig. 13) similar to the projecting ledge **139**. The double springing may be desirable in cases where appreciable strength and great evenness of operation are wanted.

Fig. 14 shows an assembly in which the slide tumbler **220** has been modified by the omission of a side portion, whereby a gate aperture is obtained which is open at one side, and the projecting arm **230** is provided by the remaining part of the locking end of the tumbler. This figure also illustrates a modification of the spacer member, according to which the spring seating **238**, instead of being a bore, is a recess open to the circular face of the spacer **233**, and defined by a short inner wall **264** and an outer wall **265** provided by an upward extension **266** of the ledge portion **239**, which extension also acts conveniently as a lateral guide for the free edge **267** of the arm **230**. By this modification, the spring **243** may more easily be mounted by merely slipping same into said recess **238**, and it will be held from sideway displacement by the back of the next spacer member or by the back of the end plate **45** of the shell plug (see Fig. 6). To this end, the spacer members **233** are preferably

formed without a ridge such as the ridge 42 of the spacer member illustrated in Fig. 4, as can be appreciated from the perspective view of the modified spacer shown in Fig. 15.

Figs. 16 and 17 illustrate two further variants of the slide tumbler which is here shown as made up of wire, which in the embodiment of Fig. 16 is bent as shown to simulate the general shape of the slide tumbler 220 shown in Fig. 14. The wire tumbler 320 of Fig. 16 may therefore be used with spacer members 333 generally similar to the spacer members 233 of Fig. 15, except that, as shown in Fig. 16, the ledge 339 has no upward extension to provide a supplementary guiding wall, but is undercut as indicated at 368 to provide room for the knee 369 of tumbler 320.

The tumbler 420 of Fig. 17 is shown as bent to a double crank shape and it will be noted that the lower leg 426 constituting the tail portion is out of alinement with the upper leg 425 constituting the locking portion. Hence the grooves 460 and 461 are also out of alinement.

Fig. 17 likewise illustrates a further feature of the invention namely the possibility of using leaf springs as the resilient means for urging the tumblers to locking position. As shown an arcuate leaf spring 543 is seated in a bore 538 normal to the end face of the spacer member 533 the ledge portion 539 of which is therefore also modified by being given an arcuate back or outer edge 570. If desired, a supplementary guide portion 571 may be provided for the upper, or locking portion of the wire tumbler 420.

Fig. 18 illustrates a further manner of utilizing a leaf spring, in combination with a plate type slide tumbler 620, in which the spring seat is provided by the under surface 628 of an offset arm 630 bent normally to the plane of the tumbler in order to engage a bowed leaf spring 643 the ends of which are seated on a pair of oppositely inclined surfaces 638, 638' provided by forming a substantially V shape slot 672 in the upper portion of the spacer member 633.

Fig. 19 I have shown an embodiment in which an arcuate leaf spring 743 similar to the spring 543 of Fig. 17 is used with a slide tumbler 720 similar to the slide tumbler 620 of Fig. 18, in combination with a spacer member 733 similar to that of Fig. 18, but modified to provide a suitable anchorage 738 for the relatively fixed end of spring 743.

Finally, in Fig. 20, I have illustrated a further possibility, namely that of providing a roller 825 to replace the gate edge 22, whereby the wear on the serrations of the key is reduced. Said roller may be formed of a short piece of steel wire, the ends of which are housed in lateral recesses 873, 873' cut in the walls 824 and 832 defining the gate aperture 821, adjacent the tail portion 826. Owing to the fact that in the assembled condition of the parts, the slide tumblers are backed and fronted by spacer members, or by the end plate and a spacer member, no particular fittings of the roller other than pushing the same into the lateral recesses is required during assembly.

While I have hereinabove described my invention with particular reference to certain preferred embodiments thereof, I do not intend to be limited thereby, but it is to be understood that I may make all such modifications therein as lie within the scope of the appended claims.

I claim:

1. A slide tumbler shell plug cylinder lock adapted to be operated by a flat key including a shank having upper and lower edges and tumbler actuating serrations in at least one of said edges, said lock comprising a hollow tubular plug of circular cross-section formed to define upper and lower longitudinal slots, an end plate at one end of said plug, a keyhole in said end plate, an annular closure cap closing the other end of said plug, a tongue plate located between said closure cap and said plug and abutting said other end, said tongue plate having offset lugs engaging said longitudinal slots to prevent rotation of said tongue plate relatively to said plug, a tongue member extending from said tongue plate through said end cap and away from said end plate, a plurality of unitary assemblies mounted in axial succession in said plug between said end plate and said tongue plate, each unitary assembly comprising a substantially circular spacer member having oppositely disposed lugs extending into said longitudinal slots, guide wall means on one face of each spacer member, each spacer member being perforated to define a key pass aperture alined into said keyhole, ward means projecting into said key pass aperture, and spring seating means, a slide tumbler having substantial extent in two dimensions located against each spacer member and including a guide edge engaging said guide wall means, each slide tumbler being shaped to define a gate aperture and a gate edge and to provide spring seat means, a resilient member extending between said spring seating means and said spring seat means for urging said tumbler to locking position, each of said tumblers being of length substantially equal to the outside diameter of said plug and being arranged therewithin with one end thereof extending into one of said slots and with the other end thereof being in alinement with the other of said slots, the gate edge of at least one of said tumblers being spaced from one of the ends of said tumbler a distance which differs from the spacings of the gate edges from the respective corresponding ends of others of said tumblers.

2. Slide tumbler shell plug cylinder lock adapted to be operated by a flat key including a shank having upper and lower edges and tumbler actuating serrations in at least one of each edges, said lock comprising a substantially cylindrical hollow tubular plug formed to define a pair of circumferentially spaced slots parallel to the axis of the plug, an end plate at one end of said plug, there being a keyhole in said end plate, an annular closure cap closing the other end of said plug, a tongue plate located between said closure cap and said plug and abutting said other end, said tongue plate having offset lug means engaging at least one of said spaced slots, to prevent rotation of said tongue plate relatively to said plug, a tongue member extending from said tongue plate through said closure cap and away from said end plate, a plurality of unitary assemblies mounted in axial succession in said plug between said end plate and said tongue plate, each unitary assembly comprising a substantially circular spacer member having outwardly directed lug means extending into at least one of said spaced slots, said spacer member being perforated to define a key pass aperture alined with said keyhole, guide wall means on one face of each spacer member, and spring seating means formed on said one face, a slide tumbler shaped to have an overall substantial extension in two dimensions, located against said one face of each spacer member and including a guide edge engaging said guide wall means, said slide tumbler being shaped to define a gate aperture and a gate edge and to provide spring seat means, a locking portion and a tail portion, each of said tumblers being of overall length substantially equal to the outside diameter of said plug and being arranged therewithin with said locking portion extending into one of said spaced slots, said tail portion alined with the other of said spaced slots and said gate aperture alined with said keyhole, a resilient member extending between said spring seating means and said spring seat means for urging said tumbler to locking position, said key pass apertures and said gate apertures each being of a size to allow the widest portion, of the key shank to pass, the gate edge of at least one of said tumblers being spaced from the end of the tail portion thereof a distance which differs from the spacings of the gate edges from the ends of the respective tail portions of others of said tumblers.

3. A slide tumbler shell plug cylinder lock adapted to be operated by a flat key including a shank having upper

and lower edges and tumbler actuating serrations in each of said edges, said lock comprising a hollow tubular plug of circular cross-section formed to define a pair of circumferentially spaced slots parallel to the axis of the plug, an end plate at one end of said plug, a key hole in said end plate of a size to pass the whole of the key shank, an annular closure cap closing the other end of said plug, a tongue plate located between said closure cap and said plug and abutting said other end, said tongue plate having offset lug means engaging at least one of said spaced slots to prevent rotation of said tongue plate relatively to said plug, a tongue member extending from said tongue plate through said closure cap, a plurality of unitary assemblies mounted in axial succession in said plug between said end plate and said tongue plate, each unitary assembly comprising a substantially circular spacer member having outwardly directed lug means extending into at least one of said spaced slots, said spacer member being perforated to define a key pass aperture alined with said key hole, guide wall means on one face of each spacer member, and spring seating means formed on said one face, a slide tumbler shaped to have an overall substantial extension in two dimensions, located against said one face of each spacer member and including a guide edge engaging said guide wall means, said slide tumbler being shaped to define a gate aperture and a gate edge and to provide spring seat means, a locking portion and a tail portion, each of said tumblers being of overall length substantially equal to the outside diameter of said plug and being arranged therewithin with said locking portion extending into one of said spaced slots and said tail portion alined with the other ones of said spaced slots and said gate aperture alined with said key hole, a resilient member extending between each of said spring seating means and the respective spring seat means for urging said tumblers to locking position, said key pass apertures and said gate apertures each being of a size to allow the widest portion of the key shank to pass, said unitary assemblies forming a first set in which the tail portions of said tumblers are alined with one of said spaced slots and a second set in which the tail portions of said tumblers are alined with the other of said slots, the gate edge of at least one of the tumblers of each set being spaced from the end of the respective tail portion a distance which differs from the spacings of the gate edges from the ends of the respective tail portions of the other tumblers, whereby each of said edges of the shank portion of the key cooperates in retracting the tumblers to unlocked position.

4. A slide tumbler shell plug cylinder lock adapted to be operated by a flat key including a shank having upper and lower edges and tumbler actuating serrations in at least one of said edges, said lock comprising a hollow tubular plug of circular cross-section formed to define at least one pair of circumferentially spaced slots parallel to the axis of the plug, an end plate at one end of said plug, a key hole in said plate, an annular closure cap closing the other end of said plug, a tongue plate located between said closure cap and said plug and abutting said other end, said tongue plate having offset lug members engaging at least one of said slots to prevent rotation of said tongue plate relatively to said plug, a tongue member extending from said tongue plate through said closure cap, a plurality of unitary assemblies mounted in axial succession in said plug between said end plate and said tongue plate, each unitary assembly comprising a substantially circular spacer member having outwardly directed lug means extending into at least one of said slots, said spacer member being perforated to define a key pass aperture alined with said key hole, guide wall means on one face of each spacer member, and spring seating means formed on said one face, a slide tumbler shaped to have an overall substantial extension in two dimensions located against said one face of each spacer member and including a guide edge engaging said guide wall means, said slide tumbler being shaped to define a gate aperture and a gate edge and to provide spring seat means, a locking portion and a tail portion, each of said portions having a free end, each of said tumblers being of overall length substantially equal to the outside diameter of said plug and being arranged therewithin with said locking portion extending into one of the slots of a pair of said slots and the tail portion alined with the other slot of said pair and with said gate aperture alined with said key hole, a resilient member extending between said spring seating means and said spring seat means for urging said tumbler to locking position, said key hole, said key pass apertures and said gate apertures each being of a size to allow the widest portion of the key shank to pass therethrough, the gate edge of at least one of said tumblers being spaced from the free end of the respective tail portion thereof a distance which differs from the spacings of the gate edges from the free ends of the respective tail portions of others of said tumblers.

5. A slide tumbler shell plug cylinder lock adapted to be operated by a flat key including a shank having upper and lower edges and tumbler actuating serrations in at least one of said edges, said lock comprising a hollow tubular plug of circular cross-section formed to define at least one pair of circumferentially spaced slots parallel to the axis of the plug, an end plate at one end of said plug, a key hole in said plate, an annular closure cap closing the other end of said plug, a tongue plate located between said closure cap and said plug and abutting said other end, said tongue plate having offset lug members engaging at least one of said slots to prevent rotation of said tongue plate relatively to said plug, a tongue member extending from said tongue plate through said closure cap, a plurality of unitary assemblies mounted in axial succession in said plug between said end plate and said tongue plate, each unitary assembly comprising a substantially circular disc like spacer member having outwardly directed lug means extending into at least one of said slots, said spacer member being perforated to define a key pass aperture alined with said key hole, a guide wall projecting from one face of each spacer member on one side of said key pass aperture and extending parallel to a diameter of said member alined with said lug means, a ledge projecting from said one face of each spacer member on the other side of said key pass aperture and perforated to define a bore extending parallel to said diameter and forming a spring seating, a substantially rectangular tumbler plate located against said one face of a respective spacer member, and including a guide edge engaging said guide wall, said tumbler plate being perforated to define a gate aperture and a gate edge, an arm extending laterally from and coplanar with said tumbler plate said arm having a lower straight edge defining a spring seat, each tumbler having a locking portion including a free end and a tail portion, and being of overall length substantially equal to the outside diameter of said plug, said tumblers being arranged within said plug with said locking portions extending into one of the slots of a pair of said slots and the tail portions alined with the other slot of said pair and with said gate apertures alined with said key hole, a resilient member extending between each of said spring seatings and said spring seats for urging said tumblers to locking position, said key hole, said key pass apertures and said gate apertures each being of a size to allow the widest portion of the key shank to pass therethrough, the gate edge of at least one of said tumblers being spaced from the free end of the respective tail portion thereof a distance which differs from the spacings of the gate edges from the free ends of the respective tail portions of others of said tumblers.

6. A slide tumbler shell plug cylinder lock adapted to be operated by a flat key including a shank having upper and lower edges and tumbler actuating serrations

in at least one of said edges, said lock comprising a hollow tubular plug of circular cross-section formed to define at least one pair of circumferentially spaced slots parallel to the axis of the plug, an end plate at one end of said plug, a key hole in said plate, an annular closure cap closing the other end of said plug, a tongue plate located between said closure cap and said plug and abutting said other end, said tongue plate having offset lug members engaging at least one of said slots to prevent rotation of said tongue plate relatively to said plug, a tongue member extending from said tongue plate through said closure cap, a plurality of unitary assemblies mounted in axial succession in said plug between said end plate and said tongue plate, each unitary assembly comprising a substantially circular disc like spacer member having outwardly directed lug means extending into at least one of said slots, said spacer member being perforated to define a key pass aperture alined with said key hole, guide wall means on one face of said spacer member, spring seating means formed in said spacer member, a slide tumbler of wire bent to have an overall substantial extension in two dimensions and to define a guide edge engaging said guide wall means, a gate aperture, a gate edge, a locking portion, a tail portion and spring seat means, each of said portions having a free end, each of said tumblers being of overall length substantially equal to the outside diameter of said plug and being arranged therewithin with said locking portion extending into one of the slots of a pair of said slots and the tail portion alined with the other slot of said pair and with said gate aperture alined with said key hole, a resilient member extending between said spring seating means and said spring seat means for urging said tumbler to locking position, said key hole, said key pass apertures and said gate apertures each being of a size to allow the widest portion of the key shank to pass therethrough, the gate edge of at least one of said tumblers being spaced from the free end of the respective tail portion thereof a distance which differs from the spacings of the gate edges from the free ends of the respective tail portions of others of said tumblers.

7. A slide tumbler shell plug cylinder lock according to claim 4 in which said resilient member is a coil spring.

8. A slide tumbler shell plug cylinder lock according to claim 4 in which said resilient member is a leaf spring.

9. A slide tumbler shell plug cylinder lock according to claim 4 in which at least some of said tumblers include lateral oppositely disposed recesses communicating with said gate aperture and a roller member having ends journalled in said recesses, said roller member constituting the gate edge.

10. A slide tumbler shell plug cylinder lock adapted to be operated by a flat key including a shank having upper and lower edges and tumbler actuating serrations in at least one of said edges, said lock comprising an open-ended hollow tubular plug defining at least one longitudinal slot, an end plate having a key hole therein closing one of said open ends and a cap closing the other of said open ends, a plurality of composite units each comprising a guide member, a slidable tumbler and resilient biasing means mounted within the hollow of said tubular plug in a plane transverse to the longitudinal axis thereof, said guide member being provided with a key hole and a lug projecting through said slot and holding said guide member non-rotatable in said plug, said tumbler having a laterally projecting arm positioned within the hollow of said tubular plug with the combined width of said tumbler and said arm exceeding the width of said slot to prevent said tumbler from being forced through said slot, said slot extending to the end of said tubular plug closed by said cap whereby said composite units may be mounted within the hollow of said plug by inserting said units through the open end of said plug normally closed by said cap prior to securing said cap in closing position upon the last named open end of said plug.

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