The present invention relates in general to tumbler wheels for use in combination locks, and in particular to key change type tumbler wheels of low density material especially designed to minimize the risk of compromise of the lock combination by radiography techniques involving the use of X-rays or other high energy radiation.

Locks of the type commonly referred to as combination locks depend for their operation upon the alignment of a plurality of disc elements, commonly called tumbler wheels, in a preselected manner to permit retraction of a reciprocating bolt from its projected position. Each tumbler is provided with a peripheral recess, commonly termed a gate, designed to receive a bar or fence normally disposed in overlying relation with the tumbler wheel peripheries and extending from a fence lever which is pivoted or otherwise coupled to a bolt and controls movement of the latter. When the tumbler gates are all disposed in registry with each other and in preselected alignment with the fence, and a driving cam which effectuates angular adjustment of the tumbler wheels through lost-motion connections and controls the fence lever is adjusted to a selected angular position, the fence may drop into the tumbler gates and permit such an interconnection of the fence lever with the driving cam that limited arcuate movement of the driving cam will impart movement to the fence lever to retract the bolt. The security of such locks is dependent upon the fact that the number of orders or permutations of the possible relative positions of the tumbler gates before all of the tumbler gates come into registry with the fence to permit retraction of the bolt is so large that the chance of these gates being aligned by a person not familiar with the combination is negligible.

In recent years, mechanical arrangements have been devised which are reasonably effective to protect the combination lock against mechanical manipulation thereof by unauthorized persons to surreptitiously detect the combination. However, various techniques have been developed in recent years for compromising the security of combination locks in safes and other security closures by the use of high-energy radiation. These have been variously termed radiography or radiological techniques and in general involve the production of pictures or other types of images of the lock works by photographing high-energy radiation which has passed through the lock mechanism. With the developments made in portable radiation sources, unauthorized persons may enter on the premises containing a security container and by radiological methods determine the combination setting of the lock and secure unauthorized entry to the protected enclosure in a short time without leaving any evidence of compromise of the lock combination.

Various arrangements have been devised in an effort to protect combination locks comprising the combination by such radiographic techniques, including particularly the provision of radiant energy scattering devices disposed within the lock housing, especially in surrounding relation to the tumbler wheels, to effect scattering of the radiating radiation and thereby confound the image or photograph produced by radiological techniques. Examples of such radiant energy scattering devices may be found in earlier U.S. Patents Nos. 2,970,217 and 3,024,640.

In order to further insure protection against unauthorized persons obtaining a radiographic image which will permit observation of the angular locations of the tumbler gates despite the presence of such radiation scattering devices, it is desirable that the tumbler wheels, or at least the peripheral portions thereof, be formed of lower density material than the metallic materials conventionally employed in the construction of lock tumbler wheels, to minimize the production of X-ray or high energy radiation shadows which would reveal tumbler gate positions.

An object of the present invention, therefore, is the provision of a novel tumbler wheel construction for tumbler wheels of combination locks and the like wherein peripheral portions of the tumbler wheel having the fence gate therein are formed of low density material to minimize the production of penetrating radiation shadows therefrom.

Another object of the present invention is the provision of a novel tumbler wheel for combination locks and the like of the changeable perimeter type wherein at least angularly adjustable perimeter portions of the tumbler wheel having the fence-receiving gate therein are wholly formed of a low density material which minimizes production of radiographic images thereof.

Another object of the present invention is the provision of a novel tumbler wheel for combination locks of the type described in the immediately preceding paragraph, wherein the tumbler wheel is of the key changeable type.

Another object of the present invention is the provision of a novel construction for key change type changeable tumbler wheels for combination locks, wherein the peripheral portion of the tumbler wheel is formed of relatively circumferentially adjustable sections operative to narrow the width of the peripheral gate therein to a size preventing entry of the fence into the gate during changing of the tumbler wheel combination setting without requiring the use of facilities exterior of the tumbler wheel to prevent such fence entry.

Other objects, advantages, and capabilities of the present invention will become apparent from the following detail description, taken in conjunction with the accompanying drawings illustrating several preferred embodiments of the invention.

In the drawings:
FIGURE 1 is an exploded perspective view of a combination lock tumbler wheel embodying the present invention;
FIGURE 2 is a front elevation view of the tumbler wheel with the tumbler wheel components disposed in locked position;
FIGURE 3 is a front elevation similar to FIGURE 2, but illustrating the components in unlocked position;
FIGURE 4 is a bottom view of the tumbler wheel shown in FIGURE 2;
FIGURE 5 is a transverse section view to enlarged scale, taken along the line 5—5 of FIGURE 2;
FIGURE 6 is an elevation view of the tumbler wheel cover viewed from the inside thereof;
FIGURE 7 is an elevation view of the tumbler wheel case, viewed from the inside thereof;
FIGURE 8 is a perspective view of a modified form of the fly to be employed in the rearmost tumbler wheel of locks of a special construction;
FIGURE 9 is a transverse section view of a modified hub construction;
FIGURES 10 and 11 are elevation views of the tumbler wheel case and cover, respectively, of a modified form, viewed from the inside thereof; and
FIGURE 12 is an elevation view of another form of the case and the side thereof.
Referring to the drawings, wherein like reference characters designate corresponding parts throughout the several figures, and especially to the form shown in FIGURES 1 to 7, inclusive, there is illustrated a tumbler wheel 10 embodying the principles of the invention. The specific tumbler wheel illustrated is particularly constructed to serve as an outer tumbler and the rearmost tumbler (nearest the driving cam) in a pack of three coaxial tumblers for a conventional combination lock of the type where the dial spindle extends coaxially through the hollow post on which the tumblers are mounted and has a conventional drive cam on the rear end of the spindle. The outer periphery of which an eccentric drive pin extends to engage and drive the rearmost tumbler, or in locks of this general type having additional facilities for preventing surreptitious operation such as U.S. Patent No. 2,575,674.
The tumbler wheel 10, in the preferred embodiment, comprises a hub member 11 having a cylindrical center opening 12 of appropriate diameter to fit over the usual boss or tumbler post of the lock case, an outer annular rib 13 of smaller axial width than the main body portion 14 of the hub 11 centered axially with respect to the latter and having a serrated outer periphery 15, and the body portion 14 having an annular groove 16 therein to face rearwardly of the pack toward the drive cam. The main body portion forming the base surface of the groove 16 is bored at one circumferential position to receive a drive pin 17 therethrough, having an enlarged head 17a at one end to lie within the groove 16 and a projecting shank portion 17b which is preferably surrounded by a sleeve 18 over the portion thereof exposed forwardly of the body portion 14 to form the drive pin to rotate the next forward tumbler wheel of the pack.
A fly 19 is fitted in the groove 16 for limited rotation to provide the desired latching motion between successive tumbler wheels, and comprises a cylindrical inner rim portion 20 to rotatably seat against the inner side wall of the groove 16, a thin circular flange portion 21 adapted to lie against the base wall of the groove 16 having an arcuate recess 22 therein to receive the head 17a of the drive pin 17b to permit limited rotary movement of the fly 19 relative to the hub 11, and a raised stop formation 23 diametrically opposite the recess 22 against which the drive pin of the drive cam or adjacent tumbler wheel abuts to transfer driving movement thereto.
The outer annular rim portion of the tumbler wheel 10, generally indicated by the reference character 25, which is designed to be selectively angularly adjustable, is adapted to receive and engage the outer flange portion 26 of the lock case and cover and has an eccentric cam extension 27. Intermediate the outer and inner flange formations 28, 30 is an annular body portion 31 provided with a series of circumferentially spaced rectangular wells 32 which are elongated along radii of the wheel case 26 and define slide chambers therein opening through an inner surface of the wheel case through the side thereof.
The wheel case 26 also includes a circular recess 33 along one circumferential zone of the annular body portion 31 to form a journal opening for a key change cam to be later described, and a peripheral gate forming recess 34 is provided along the portion of the wheel case diametrically opposite the circular recess 33, bounded by radially enlarged peripheral extensions 35 having serrated outer surfaces 35a. The wheel case 26 also has a radially projecting arcuate extension 36 diametrically opposite the extension portions 35, the total arcuate extent of the extension 36 and the total angular range between the ends of the extensions 35 remote from the recess 34 being sufficient for an eccentric cam.
The elongated wells or slide chambers 32 provide guiding support for a plurality of locking blocks 37 of generally rectangular configuration having serrated teeth 38 along the inwardly facing surface thereof disposed along a slightly arcuate path substantially conforming to the curvature of the serrated annular rib 13, the locking blocks 37 being shallower in radial extent than the wells 32 to permit radial sliding movement of the blocks 37. The blocks 37 have an inwardly extending offset along the outer part 39 of a lateral face thereof providing an inclined surface or land 40 facing radially outwardly of the tumbler wheel to be acted upon by inclined cam surfaces of the wheel cover 27 as hereinafter described.
The wheel cover 27 is adapted to be releasably assembled with the wheel case 26 on the hub 11 and to be rotatable through a small arc relative to the wheel case 26, and to this end comprises an annular disk-like body portion 41 having a smaller diameter edge 42 bounding a circular opening corresponding to the diameter of the main body portion 14 of the hub 11 conforming in cross section to and adapted to fit in the annular rabbot 29 between the annular rib 13 of hub 11 and the adjacent end of the outer flange portion 14. The outer or larger diameter end of the wheel cover 27 is formed by a flange 43 adapted to project to the plane of the external surface of the wheel case 26 and having a retaining bead 44 thereon adapted to snap over the bead 30a on the outer flange formation 30 of the wheel case to retain the wheel case to the wheel cover. The flange 43 has a continuously serrated outer periphery as indicated at 45 and is interrupted at two places as indicated at 46 and 47 to accommodate the radial extensions 35 and 36 of the wheel case 26, the arcuate extent of these interruptions 46, 47 being somewhat greater than that of the extensions 35, 36, for example about 50°. The wheel cover 27 is provided with a peripheral fence-receiving gate 48 conforming in profile to the gate 34 in the wheel case and adapted to be normally aligned therewith and has a circumferentially elongated aperture 49 therein for journaling the combination changing cam to be later described. A generally annular well 50 is provided in the inner surface of the wheel cover adjacent the central aperture bounded by the edge 42 to receive the laterally enlarged portions of the locking blocks 37 and is outwardly bounded by a block control surface 51 having a series of generally saw-tooth shaped zones 52 thereon to bear against the inclined surfaces or lands 40 of the locking blocks 37 and effect radially inward movement of the latter.
A combination changing cam 53 having a pair of circular end portions 54 projecting through the apertures 33, 49 of the case 26 and cover 27 lies between the case and cover and has an eccentric cam extension 55 projecting from the circular portion thereof, normally lying to the
left of the axis of the cam 53 as viewed in FIGURE 2. The cam periphery has a small spherical knob formation 56 thereon adapted to lie in a correspondingly configured recess 57 of the wheel case 26 when the wheel case is rotated to restrain the cam against rotation from its normal position through frictional interaction of the knob formation 56 with the socket 57. The cam 53 also includes a rectangular or other non-circular central opening 58 to receive a combination change key therethrough to permit rotation of the cam 53 about its axis. The wheel cover 27 is provided with a shoulder 59 between a recess 49 to be engaged by the eccentric cam extension 55 upon rotation of the cam to the locked position illustrated in FIGURE 2 and thereby effect relative rotation between the wheel case 26 and wheel cover 27 to bring these elements into a desired state of alignment wherein the gate-forming recesses 34 and 48 register with each other. Each of the wheel case 26, wheel cover 27, locking blocks 37 and combination changing cam 53 is preferably formed of low density material such as the aforementioned Delrin acetal resin to minimize the production of any detectable radiation shadows from the outer rim assembly by which the combination could be detected.

It will be appreciated that the outer annular rim assembly 25 of the tumbler wheel can be readily assembled with the hub 11 by fitting the cam 53 and the locking blocks 37 in the aperture 33 and wells 32 of the wheel case 26, assembling the wheel cover 27 with the wheel case 26 in the manner previously described, and with the cam 53 in the unlocked position illustrated in FIGURE 3, fitting the outer rim assembly 25 over the hub 11 until the teeth 38 of the locking blocks 37 are radially aligned with the serrated outer periphery 15 of the annular rib 13. In this condition of the outer annular rim assembly the wheel case 26 occupies a circumferentially spaced angular position wherein the gate-forming recess 34 therein is out of alignment with the gate-forming recess 48 of the wheel cover providing a narrower opening than the width of the fence, and the saw-tooth shaped zones 52 of the blocking surfaces 51 are spaced with the shoulder 59 on the wheel cover 27 and effects relative angular movement between the cover 27 and case 26 to bring the gate-forming recesses 34 and 48 into registry as illustrated in FIGURE 2. Such movement of the wheel cover 27 and the blocking surfaces 51 thereon through interaction of the saw-tooth shaped zones 52 with the inclined surfaces 40 of the locking blocks 37 also forces the locking blocks 37 radially inwardly until their teeth 38 interlock with the teeth 15 on the hub rib 13, to thereby restrain the outer annular rim assembly 25 against further rotation relative to the hub 11 until the combination change cam 53 is readjusted to unlocked position.

In order to change the tumbler wheel combination when the tumbler wheels are assembled in a lock, the combination change key is inserted into the non-circular opening 58 of the cam 53 and the cam is rotated in a counterclockwise direction. As illustrated in FIGURES 2 and 3, move the cam to the unlocked position, during which the eccentric cam extension 55 engages another shoulder formation 60 on the wheel cover 27 to rotate the wheel cover 27 relative to the wheel case 26 to the unlocked position and thereby release the locking blocks 37 for radial outward movement. The combination lock dial and driving cam of conventional construction may then be advanced through the new combination desired, during which the hubs 11 of the three tumbler wheels will be adjusted in a well-known manner in accordance with the new combination settings to new angular positions relative to their associated annular rim assemblies, the rim assemblies being held against movement by the combination change key projecting through the non-circular change cam openings. In this condition of the rim assemblies, the tumbler gates defined by the gate portions 34 and 48 are narrower than the recess 49 to the angular misalignment of the cover 27 and case 26, so that the fence cannot in any event enter or jamb the case and cover. When the new combination has been set, the combination change key is adjusted to return the cams 53 to locked position, interlocking the rim assemblies with their respective hubs at the new positions and the change key is then withdrawn.

It will also be appreciated that during adjustment of the combination lock dial and driving cam, whether the tumbler wheels be in combination change position or not, the drive pin of the drive cam will project into the annular groove defined by the groove 16 in the hub 11 and the thin portion 20 of the fly 19 therein, and upon a suitable extent of rotation of the drive pin, the drive pin will engage the stop formation 22 and rotate the fly 19 until one edge of the recess 22 engages the head of the drive pin 17 of that tumbler wheel to effect rotation of that tumbler wheel. The drive pin 17, at the portion thereof projecting from that tumbler wheel, extends into the corresponding recess of the next forwardly disposed tumbler wheel to drive it in the like manner with the desired lost-motion properties. It is of course unnecessary to have a forwardly projecting shank portion of sleeve 18 for the drive pin of the forwardmost tumbler wheel, since there is no additional tumbler wheel to be driven thereby, in which event the sleeve 18 may be eliminated and the shank of the drive pin may be foreshortened.

Still further modification should be provided on the rearmost tumbler wheel wherein the tumbler wheels are designed to be used with combination locks of the type illustrated in U.S. Patent No. 2,807,954 wherein a radially adjustable protective slide is provided on the drive cam to normally cover the drive gate, which slide has the drive pin for adjusting the rearmost tumbler fixed thereon, so that the drive pin moves radially outwards of the tumbler wheel system upon adjustment of the slide to gate opening position. In this case, the drive pin on the drive cam slide cannot project into the groove 16, and a modified fly 19' must be provided as illustrated in FIGURE 8, having a head or projection 23' provided with an angular cam surface 24' facing radially outwardly of the tumbler wheel axis, all for the purposes disclosed in said earlier U.S. Patent No. 2,807,954.

FIGURE 9 illustrates a slightly modified hub structure wherein the separate drive pin for the hub 11 is eliminated, and the projecting portions thereof for engaging the stop formation on the fly of the next adjacent tumbler wheel and for limiting rotation of its own associated fly are provided by merely bending tabs of metal from the main body portion 14 of the hub axially forward and rearward as indicated at 14a and 14b.

Referring now to FIGURES 10 and 11, showing a modified form of tumbler wheel embodying the present invention, wherein radially movable locking segments are employed rather than the plurality of locking blocks of the previously-described embodiments, the hub component of the fly component for this modified tumbler wheel form are identical to that embodied in the previously described form and thus are not illustrated in FIGURES 10 and 11. The wheel case of this embodiment is illustrated in FIGURE 10 and is designated by the reference character 61. The wheel case 61 is similar in profile and section to the wheel case 26, having an inner flange portion 62, an outer flange formation 63 and an intermediate annular body portion 64, together with a circular aperture 65 to receive and journal one of the circular portions 54 of the cam 53 and a peripheral gate forming recess 66, bounded by serrated radially projecting segments 67 corresponding to the segments 35c of the first described embodiment. However, instead of hav-
ing wells or slide chambers for supporting and guiding locking blocks, the inner surface of the annular body portion 64 is flat and a plurality of circumferentially spaced, parallel, outwardly extending guide slots 68 are provided therein to locate and provide sliding support for a pair of locking segments 69, 69', having projecting lugs 70 fitting into the slots 68. The locking segments 69, 69' surrounds the periphery of the hub rim 13 over a substantial arcuate range, for example about 90°, and include the arcuate main body portion 71, having a serrated inner face 72 and a plurality of raised knobs or cylindrically curved formations 73 on the outer surface thereof.

The wheel cover 74 of this embodiment is similar in configuration to the wheel cover 27 of the first described embodiment, having a disk-like body portion 75, a smaller diameter edge 76, and an outer peripheral flange 77 corresponding to the body portion 41, edge 42 and flange 43 of the first-described embodiment. The cover 74 similarly includes serrations 78 on the flange 77, interrupted by flange 80 in the flange 77 to accommodate the projecting peripheral portions of the wheel case, a gate-forming recess 81, and an elongated aperture 82 to receive the other circular portion 54 of the combination changing cam 53. Shoulder formations 83 and 84 corresponding to the shoulder formations 59 and 60 of the first described embodiment are also provided to contact with the eccentric cam extension 55 of the cam 53 in a similar manner to selectively effect relative rotation of the wheel cover 74 with respect to the case 61. A locking segment controlling surface of generally cylindrical configuration, indicated at 85 is provided in the inner surface of the wheel cover 74 having a plurality of arcuate sockets 86 therein corresponding in number and location to the curved formations 73 on the locking segments to permit the curved formations 73 of the locking segments to nest therein and permit sufficient radial outward movement of the locking segments 69, 69' to free the hub 11 for rotation relative to the wheel case and cover, when the wheel cover 74 is adjusted to the unlocked position wherein the cover 74 is disposed at its limit angular position locating its associated gate-forming recess 81 out of registry with the gate-forming recess 66. It will be apparent that when the combination changing cam 53 is adjusted to rotate the wheel cover to the locked position wherein the gate-forming recess 81 registers with the gate-forming recess 66, the segment controlling surface 85 of the wheel cover is oriented so that the sockets 86 thereof are out of registry with the curved formations 73 with the segments 69, 69', thereby forcing the segments radially inwardly to interlock the serrations 72 thereon with the serrated surface 15 of the hub rim 13.

FIGURE 12 illustrates a further modification of the wheel case component which may be used with the wheel cover 74. The wheel case of the embodiment illustrated in FIGURE 12 is indicated by the reference character 61, and is constructed similar to the wheel case 61 of FIGURE 10, the elements of the former which correspond to those of the latter being indicated by reference characters which are the primes of the reference characters employed for the FIGURE 10 embodiment. However, instead of providing guide slots 68 for use with locking segments 69, 69', the embodiment shown in FIGURE 12 provides a plurality of circumferentially spaced small serrated lugs or jaws 88 having radially inwardly facing serrated surfaces 89 adapted to selectively engage the serrated periphery 15 of the hub rim 13. The lugs or jaws 88 are positioned to register with the sockets 86 when the wheel cover 74 is moved to the locked position and the sockets 86 are spaced out of alignment when the lugs 88 so as to interfit with the serrations on the hub rim 13 and prevent relative movement between the case 61 and cover 74, on the one hand, and the hub 11 on the other.

It will be apparent from the foregoing description that the various embodiments hereinafter described provide a tumbler wheel for combination locks of the type wherein the combination may be changed by insertion of a suitable combination change key in the lock, and wherein the peripheral portions of the tumbler wheel located outwardly of and selectively moveable relative to the tumbler wheel hub may be readily made of nonmetallic material which will reduce the possibilities of production of radiograph shadows which will reveal the location of the gatings on the tumbler peripheries. Further, the structure hereinafter described effects contraction of the effective size of the tumbler gates when the tumbler wheels are adjusted to a combination changing condition to retard entry of the fence into the tumbler gatings.

While several preferred embodiments of the present invention have been particularly shown and described, it is apparent that various modifications may be made therein within the spirit and scope of the invention, and it is desired, therefore, that only such limitations be placed on the invention as are imposed by the prior art and set forth in the appended claims.

What is claimed is:

1. A tumbler wheel for combination locks and the like comprising an annular hub member including an outer peripheral surface having a plurality of interlocking formations extending circumferentially thereof, an annular peripheral ring assembly concentrically surrounding the hub periphery comprising a pair of annular lock members having corresponding peripheral recesses therein defining a fence-receiving gate, said ring members being supported on said hub in side-by-side relation for relative angular adjustment thereof from a normal relative position aligning said corresponding peripheral recesses with each other to a release relative position angularly spaced therefrom, ring interlock elements supported by at least one of said ring members for selectively interlocking the ring assembly with said hub interlocking formations against rotation relative to said hub member, and means positioned by rotation of said other ring member relative to said one ring member for forcing said interlock elements into interlocked relation with the hub interlocking formations when said ring members occupy said normal relative position and releasing said interlock elements relative to said interlocking formations to free said ring assembly for rotation relative to said hub when said ring members occupy said release relative position.

2. In a tumbler wheel for combination locks and the like, the combination defined in claim 1, wherein all of the components of said annular ring assembly are formed of low density plastic material minimizing production of detectable shadows thereof by X-ray and like penetrating radiation.

3. A tumbler wheel for combination locks and the like comprising an annular hub member having a central opening therethrough adapted to be journalled on a support therefor in a combination lock, said hub member including an outer peripheral surface having a plurality of interlocking formations extending circumferentially thereof, an annular peripheral ring assembly coaxially surrounding said hub member and hub peripheral circumferentially relative thereto to vary the combination of the lock comprising a pair of annular ring members arranged in side-by-side relation concentric with said hub having corresponding peripheral recesses therein defining a fence-receiving gate, said ring members including means coupling the same together and permitting relative angular adjustment thereof from a normal relative position allowing said corresponding peripheral recesses with each other
to a release relative position angularly spaced therefrom, ring interlocking elements supported by at least one of said ring members with respect to said hub member, and integral shoulder means on said second ring member bearing against said interlocking elements for forcing said interlocking elements into interlocking relations with the hub teeth when said second ring member occupies said normal relative position and releasing said interlocking elements from said locking relation with said hub teeth to free said hub and ring assembly for relative rotation when said second ring member occupies said release relative position.

7. In a tumbler wheel for combination locks and the like, the combination defined in claim 6 wherein said interlocking elements comprise substantially rectangular integral grooves having teeth on one face thereof facing toward said hub rim and a lateral inclined shoulder, said first ring member includes radially elongated recesses therein slidably supporting said blocks and guiding the same for radial movement relative to said hub member, and said integral shoulder means on said second ring member having radially inwardly facing inclined shoulder formations thereon bearing against said inclined shoulders on said blocks positioned to force said blocks radially inwardly upon movement of said second ring member toward said normal relative position and release the same for radial movement during movement of said second ring member toward said release relative position.

8. In a tumbler wheel for combination locks and the like, the combination defined in claim 6 wherein said interlocking elements comprise a pair of arcuate segment members having inwardly facing serrated surfaces conforming substantially to the curvature of segments of said hub rim and having radially outwardly projecting segments on the opposite surface thereof, said first ring member having means slidably supporting said segment members for radial movement relative to said hub member, and said integral shoulder means on said second ring member having arcuate shoulder formations integral therewith including surface portions positioned to engage said lobes and force the segment members inwardly into interlocking relation with said hub rim when said second ring member occupies said normal relative position and including socket portions to register with and accommodate said lobes to release said segment members from locking relation with said hub teeth when said second ring member occupies said release relative position.

9. In a tumbler wheel for combination locks and the like, the combination defined in claim 6 wherein said interlocking elements are feasible integral stub members on said first ring member projecting axially between said first and second ring members and having teeth on radially inwardly surfaces thereof to interlock with said rim teeth and convex radially outward surfaces, and said integral shoulder means on said second ring member having shoulder formations thereon including recessed portions for accommodating the convex surface portions of said stub members at an outer limit position freeing said hub and ring assembly for relative rotation when said second ring member occupies said release relative position and having other portions for flexing said stub members inwardly into interlocking relations with said rim teeth when said second ring member occupies said release position.

10. In a tumbler wheel for combination locks and the like, the combination defined in claim 6 wherein all of the components of said annular ring assembly are formed of low density plastic material minimizing production of detectable shadows thereof by X-ray and like penetrating radiation.

11. A tumbler wheel for combination locks and the like comprising an annular hub member having a central opening therethrough adapted to be journaled on a support therefor in a combination lock, said hub member including an outer periphery having a narrow circumferential rim provided with interlocking teeth, an outer angular peripheral rim assembly coaxially surrounding said hub periphery and selectively movable circumferentially relative thereto to vary the combination of the lock, said annular rim assembly comprising first and second ring members adapted to be aligned respectively with opposite end surfaces of said hub member, said first and second ring members having corresponding peripheral recesses therein defining a fence-receiving gate and including means for coupling the same together against relative axial displacement while permitting angular adjustment of said second ring member relative to the said ring member from a normal relative position aligning said corresponding recesses with each other to a release relative position angularly spaced therefrom, a plurality of interlocking elements having formations thereon to interlock with said teeth carried by said first ring member between said ring members for radial movement relative to said hub member into and out of interlocking relation with said teeth, cam means supported for rotation in said ring assembly for angularly adjusting said second ring member to said normal and release relative positions with respect to said first ring member, and integral shoulder means on said second ring member bearing against said interlocking elements for forcing said interlocking elements into interlocking relations with the hub teeth when said second ring member occupies said normal relative position and releasing said interlocking elements from said locking relation with said hub teeth to free said hub and ring assembly for relative rotation when said second ring member occupies said release relative position.
outer angular peripheral ring assembly coaxially surrounding said hub periphery and selectively moveable circumferentially relative thereto to vary the combination of the lock, said annular ring assembly comprising an annular ring cover and an annular ring case having circular inner edges to rotatably seat in said rabbets, said cover and case having corresponding peripheral recesses therein defining a fence-receiving gate and including means for coupling the same together against relative axial displacement while permitting relative angular adjustment of said cover from a normal relative position aligning said corresponding recesses with each other to a release relative position angularly spaced therefrom, a plurality of interlocking elements having serrated surfaces thereon to interlock with said serrated rim carried by said case between said case and cover for radial movement relative to said hub member into and out of interlocking relation with said serrated rim, cam means supported for rotation in said ring assembly for angularly adjusting said cover to said normal and release relative positions with respect to said case, and integral shoulder means on said cover bearing against said interlocking elements for forcing said interlocking elements into interlocking relations with the serrated rim when said cover occupies said normal relative position and releasing said interlocking elements from locking relation with said serrated rim to free said hub and ring assembly for relative rotation when said cover occupies said release relative position.

References Cited by the Examiner

UNITED STATES PATENTS

2,807,954 10/1957 Miller -------------- 70—333

JOSEPH D. SEERS, Primary Examiner.

BOBBY R. GAY, Examiner.