The present invention relates in general to combination locks, and more particularly to combination locks of the exposed shackle padlock type having facilities for improving the security of such locks against unauthorized manipulation.

Combination locks of the type having an exposed U-shaped shackle of hardened steel wherein one leg of the shackle is slidably and rotatably retained within the padlock casing and the other leg which is of shorter length is operatively associated with a complementary recess or socket in the padlock casing to be retained in seated relation in the recess when in locked condition and to be slidably withdrawn from the padlock casing have been most commonly provided with key-controlled locking mechanisms. These exposed shackle padlocks are particularly useful in locking closure covers having hasps and hasp staples by inserting the free end of the shackle through the hasp staple and then rotating the shackle to closed relation and locking the shackle within its casing to retain the hasp in closed relation with its associated hasp staple.

Some attempts have been made in the past to incorporate combination lock principles into these exposed shackle padlocks. Such attempts have had as their principal aim the provision of a plurality of coaxially associated peripherally recessed permutation disks or tumblers actuated individually through a lost motion connection with a rotatable dial and knob to align the disk peripheries with a fence so that limited actuation of the fence is permitted to release the end of the shorter shackle leg which is normally retained in the padlock casing and permit unlocking movement of the shackle.

Since exposed shackle padlocks are particularly suitable for use on doors or exposed applications, the lock components are readily subject to the corrosive action of climate and weather and are readily subject to attack by unauthorized personnel by drilling and like entrance procedures, which factors tend to give such padlocks short life and low security characteristics. The rapid destruction of the lock mechanism when such combination padlocks are employed in marine applications, where they are subjected to the highly corrosive action of salt water and salt spray, renders them particularly unreliable under such conditions. Further, when the tumbler actuating dials in these prior art exposed shackle combination padlocks are located externally of the padlock casing, persons seeking unauthorized operation of the lock can readily drill through the exposed dial and casing to inspect the interior of the padlock and determine the combination for which the lock is set, and then replace the damaged dial with a new matching dial so that unauthorized operation of the lock can be accomplished at will without knowledge thereof by authorized personnel.

An object of the present invention is the provision of an exposed shackle combination padlock of a novel construction design to obviate the aforesaid disadvantages.

Another object of the present invention is the provision of a novel exposed shackle padlock having an internal lock mechanism of the combination lock type including a plurality of permutation disks for improving the security of such locks.

Another object of the present invention is the provision in an exposed shackle padlock of a combination lock tumbler mechanism arranged in a manner to resist unauthorized attack upon the lock and to readily disclose penetration of the lock casing by unauthorized personnel.

Another object of the present invention is the provision of an exposed shackle combination padlock wherein the internal locking components are effectively water-proofed to protect them against exposure to climate and weather.

Another object of the present invention is the provision of an exposed shackle padlock of the type having a combination lock mechanism of the peripherally recessed tumbler-type wherein the lock mechanism components are arranged in a novel and advantageous manner.

Another object of the present invention is the provision of an exposed shackle combination padlock of the type having a plurality of peripherally recessed tumblers and a driving cam and dial, wherein means are incorporated to resist detection of the unlocking combination through manipulation of the dial.

Another object of the present invention is the provision in an exposed shackle padlock of the type having a combination lock mechanism including tumblers and a driving cam, of means for preventing contact of the fence with the tumbler peripheries during adjustment of the tumblers to improve the security of such locks.

Other objects, advantages and capabilities of the present invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings, wherein two preferred embodiments of the invention are illustrated.

In the drawings:

Figure 1 is a perspective view of a preferred form of an exposed shackle combination padlock embodying the present invention;

Figure 2 is a transverse horizontal section view of the preferred form of exposed shackle combination padlock, taken along the lines 2—2 of Figure 1;

Figure 3 is a vertical transverse section view of the preferred combination padlock, taken along the lines 3—3 of Figure 2;

Figure 4 is a horizontal transverse section view illustrating the sealing O ring and the locking arm arbor sealing gasket, taken along the lines 4—4 of Figure 3;

Figure 5 is a transverse horizontal section view illustrating the construction of the driving cam and dial, taken along the lines 5—5 of Figure 3, a part of the fence portion cooperating with the dial being broken away to reveal the portion of the fence cooperating with the tumblers;

Figure 6 is a transverse horizontal section view illustrating the arrangement of the mechanism for interlocking the dial with the casing, taken along the lines 6—6 of Figure 3;

Figure 6a is a fragmentary view corresponding with that of Figure 6, but illustrating the interlocking pin and cam in interlocked position;

Fig. 7 is a vertical transverse section view of a modified exposed shackle combination lock embodying the present invention;

Figure 8 is a bottom plan view of the modification illustrated in Figure 7, with parts of the casing broken away to illustrate the internal lock mechanism;

Figure 9 is a horizontal transverse section view of the modified form of combination padlock taken along the lines 9—9 of Figure 7; and,

Figure 10 is a section view taken along the lines 10—10 of a modified exposed shackle combination padlock having an internal lock mechanism of the combination lock type including a plurality of permutation disks for improving the security of such locks.
of Figure 7 illustrating the mechanism interconnecting the dial knob and the control spindle by which release of the fence to operatively engage the driving cam is effected.

Referring to the drawings wherein like reference characters designate corresponding parts throughout the several figures, and particularly Figures 1–6, inclusive, the preferred embodiment of the combination padlock, generally indicated by the reference character 10, comprises a generally cylindrical casing 11 having a pair of sockets 12 and 13 in the upper end wall thereof formed by the cover member 14, from which a case hardened steel U-shaped shackle 15 projects, with the short leg 16 thereof seated in the socket 12 and the long leg 17 seated in the socket 13.

The casing 11 is hollowed out to provide a chamber 18 for housing the lock mechanism. The external surface of the casing 11 extending from the upper end thereof along a major portion of the length of the casing is cylindrical in configuration and then tapers inwardly over the region indicated generally by the reference character 19 to a cylindrical end portion 20 of a smaller diameter than the major cylindrical portion of the casing and terminates in a lower end wall 21 centrally apertured at 21′.

An integral dial cam member 22 is journaled for rotation in an extension of the bore 23 within the casing 11, which projects a driving cam portion indicated by the reference character 23, an intermediate dial portion indicated by the reference character 24, and a projecting knob portion indicated by the reference character 25, which extends through the aperture 21′ in the casing end wall 21. The aperture 21′ is formed with inwardly diverging walls to bear upon the truncated conical surface 26 of the dial cam member 22 disposed immediately inwardly of the knob portion 25. An annular backing gasket 27 surrounds a cylindrical portion of the dial cam member 22 lying between the conical bearing surface 26 and dial portion 24 to prevent seepage of moisture through the casing end wall aperture 21′ and into the chamber 18 of the padlock casing 11.

The driving cam is of the general construction disclosed in my earlier Patent No. 2,575,674, issued November 20, 1951, and in my copending patent application Serial No. 441,526, filed July 6, 1954, which is provided with means for preventing operative engagement of the fence in the driving cam gate during manipulation of the driving cam to adjust the tumblers, so as to prevent unauthorized detection of the combination of the lock through the sense of touch or hearing. To this end, the driving cam portion 23 of the dial cam member 22 is provided with the usual peripheral notch or gate 28 to cooperate with a fence, to be later described, and the upwardly disposed face of the driving cam is provided with a diametrically opposed pair of spaced guide blocks 29 between which is slidably fitted a slide plate 30 whose exposed opposite ends follow arcs formed about the medial axis of the driving cam and of a radius equal to the maximum driving cam radius so that the slide plate 30 when in closed position, as illustrated in Figure 5, forms a continuation of the uninterrupted portions of the driving cam periphery to prevent admission of a fence into the driving cam gate 28.

Spaced above the dial cam member 22 in a plane perpendicular to the axis of the casing 11 is a transverse tumbler post partition member 31 supported on a shoulder formation 32 along the inner wall of the casing 11 and an integral cylindrical boss 33 projecting downwardly from the upper end portion of the partition 31. The boss 33 is provided with a cylindrical socket 34 adapted to receive and journal the upper end of a control spindle 35 which extends downwardly through a hollow bore 36 in the dial cam member 22. The other end of the control spindle 35 is provided with a knob 37 having a cylindrical flange portion journaled against the sides of the portion of the bore 36 extending into the dial cam knob portion 25, and the knob 37 having a knurled portion projecting through a complementary aperture in the lower end wall of the knob portion 25 of the dial cam 22 by which the control spindle 35 may be manipulated. Near the upper end of the control spindle 35 is an integral laterally extending tang 38 lying in the recess 39 of the slide plate 30 to shift the slide plate 30 upon rotation of the knob 37 and control spindle 35 from the gate-closing position illustrated in Figure 5 to a gate-exposing position, wherein the arcuate end of the slide 30 adjacent the driving cam gate 28 is disposed in alignment with or below the bottom of the driving cam gate 28.

To prevent admission of moisture through the aperture 25 in the end wall of the dial cam knob portion 25 and the bore 36 into the mechanism chamber 18, an annular packing gasket 39 surrounds the control spindle 35 within the bore 36.

Since it is necessary to rotate the control spindle 35 and tang 38 relative to the dial cam 22 in order to effect diametric movement of the slide plate 30 on the driving cam 22, it is provided with an interlock mechanism for temporarily interlocking the dial cam with the casing 11 during rotation of the control spindle 35 to shift the slide plate 30. This mechanism consists of an eccentric cam 40 integrally formed on the control spindle 35, which engages the inner end of an interlock pin 41 slidably supported in a radial bore 42 in the dial cam 22. The interlock pin 41 is formed with a larger diameter cylindrical portion 43 adjacent the central bore 36 in the dial cam 22 and a smaller diameter cylindrical portion 44 supported in a complementary diameter portion of the bore 42, remote from the central bore 36 and adapted to be selectively received in a complementary socket 45 in the padlock casing 11 when the dial is oriented to a preselected position, for example with its zero graduation aligned with a fixed index mark on the casing. A coil spring 46 surrounds the smaller diameter portion 44 of the pin 41 and bears against the shoulder formed between the smaller diameter portion of the bore 42 and the larger diameter portion accommodating the portion 43 of the pin 41. The coil spring 46, therefore, resiliently projects the free end of the larger diameter interlock pin portion 43 into the bore 36 to ride in the larger diameter eccentric cam 40, so that upon rotation of the control spindle 35 from its normal position wherein the slide plate 30 is in driving cam gate-closing position through 180 degrees to a position locating the slide plate 30 in driving cam gate-exposing condition, the smaller diameter portion 44 of the interlock pin 41 will be received in the socket 45, as illustrated in Figure 6,2, throughout the major portion of this rotation to interlock the dial cam 22 against rotation relative to the casing 11.

The cylindrical boss 33 of the tumbler post partition 31 has freely journaled on the periphery thereof, in the usual manner, a group of three tumblers 47, 48 and 49 of usual construction. These tumblers, in accordance with conventional practice, have an inner hub and an outer peripheral ring normally locked against rotation relative to the hub by interlocking levers which are actuated upon insertion of a rectangular cross section key into combination-changing key openings in the peripheral ring of each tumbler and rotation of the key to disengage the interlocking lever from the tumbler hub. The tumblers are held on the boss 33 against axial displacement by means of a retaining ring 50 fitted onto a complementary annular recess in the surface of the boss 33 adjacent the lower end thereof. In accordance with usual practice, a plurality of lost motion fly washers cooperating with projecting studs on the surfaces of the tumblers are disposed between the tumblers for transmitting motion from one tumbler to the other, and the lowermost tumbler 47 is provided with a stud adapted to be engaged by the driving pin 30′ on the slide plate 30 when the slide plate is in driving cam gate-closing position to transmit motion from the dial cam 22 to the tumbler 47.

Immediately above the tumbler post partition member 31 is an inner core member 51 extending generally trans-
versely of the casing 11 having a transversely arranged disk portion 52 complementary to the diameter of the mechanism chamber 18 above the shoulder 32 and having a downwardly projecting shackle mounting portion 53 at one diametrical position for supporting the long leg 17 of the shackle 15. To this end, the shackle mounting portion 53 of the core member 51 is provided with a cylindrical socket 54 complementary in diameter to the shackle leg 17. A retaining pin 55 is fixed in the core member 51 and extends slightly into the socket 54 to be received in the elongated recess 56 near the lower end of the long shackle leg 17 and permit limited rectilinear operation of the shackle leg 17 in the socket 54. At the lower limit of the recess 56 an annular recess 67 extending at least half way around the shackle leg 17 is provided to receive the projecting portion of the retaining pin 55 and permit limited rotation of the shackle 15 about the axis of the shackle leg 17.

The lower surface of the disk portion 52 of the core member 51 is recessed as indicated at 58 to receive the lock arm control lever 59 of the locking mechanism 60, the locking lever 59 being integral with the vertical arbor 61. The arbor 61 of the locking arm mechanism 60 is journaled in a complementary aperture in the core member 51 and the lower end of the arbor is seated in a socket 62 formed in the upper surface of the tumbler post partition 31 in coaxial relation above the control spindle1 joining socket 34. The upper end of the arbor 61 is journaled in a complementary socket 63 in the top cover member 14, which, together with the socket 62 and the tumbler post partition 31, forms the support for the arbor 61. Near the upper end of the locking arm mechanism 69, a locking arm 64 is pinned to the arbor 61 and held thereon by a nut 65, the opposite ends of the locking arms 64 cooperating with the locking recesses 66 and 67 in the shackle legs 16 and 17, respectively, which are aligned transversely with the locking arm 64 when the end of the short shackle leg 16 is seated in the socket 12.

Movement of the locking arm mechanism 60 is controlled by the fence 68 which is supported within the chamber 18 and 69 and arranged parallel to the axis of the tumblers with the nose 68' of the fence 68 riding on the periphery of the driving cam portion 23. The fence is resiliently biased by means of a suitable spring 70 to urge the nose thereof toward the axis of the tumblers and driving cam, so that when each of the tumbler recesses are aligned to receive the nose 68' of the fence 68 as by manipulating the dial to establish the proper combination, and the driving cam gate 28 is positioned adjacent the nose of the fence 68, and the slide plate 30 is retracted, the fence will be rotated by the spring 70 toward the axis of the tumblers from the position illustrated in Figure 5 to seat the fence nose in the gate 28 and the peripheral notch 59' in the lever 59. The upper end of the fence 68 projects into the recess 59 of the core member 51 in operative relation to contact the locking arm control lever 59 when the fence is rotated toward the axis of the tumblers under the action of the spring 70 to position setting the fence nose in the gate 28 and upon further manual rotation of the driving cam 23 and consequent further rotation of the fence, the locking arm control lever 59 and locking arm 64 are pivoted by the fence 68 in a counterclockwise direction from the solid line position shown in Figure 2, to the dotted line position. This rotation of the locking arm mechanism 60 shifts the locking arm 64 in such a manner as to move the ends thereof out of retaining relation with the locking recesses 66 and 67 of the shackle arms 16 and 17 to free the shackle for subsequent engagement of the padlock casing 11.

A ball check 71 seated in the core member 51 cooperates with the locking arm 64 to resiliently retain the locking arm in shackle-locking position.

To protect the locking mechanism chamber 18 against seepage of the moisture from the upper end of the padlock casing 31, an annular packing gasket 72 is seated in a complementary recess in the upper surface of the core member 51 in surrounding relation with the arbor 61 of the locking arm mechanism 60. Also, to resist seepage of moisture around the top cover member 14 and between the lateral surfaces of the core member 51 and tumbler post partition 31 and the walls of the chamber 18, an annular outwardly opening recess 73 is provided in the core member 51 in which an O ring 74 is seated to resiliently bear against the adjacent walls of the interior casing chamber 18.

Apertures 75 and 76 are provided in the tumbler post partition 31 and core member 51, respectively, in axial alignment with the socket 12 of the top cover member 14 designed to receive the short shackle leg 16 so as to permit insertion of a combination-changing key through the socket 12 and these aligned apertures 75 and 76 when the shackle is in unlocked position. The upper enlarged portion of the aperture 76 is threaded to receive a screw 77 for normally closing the combination change apertures and a packing disk 78 is disposed in the aperture 76 in the enlarged portion and is held in compacted position by the screw 77 to resist admission of moisture through this aperture.

The dial graduations are formed on the inclined face 79 of the dial portion 24 of the dial cam 22, a segment of these graduations being visible externally of the padlock casing through an aperture 80 which is preferably covered by a suitable transparent material.

Operation of the embodiment illustrated in Figures 1 to 65, inclusive, is as follows: Assuming the lock to be in locked condition as illustrated in Figure 2, the recesses of the tumblers 47, 48 and 49 are aligned with the projection of the fence 68 extending alongside the tumblers and locking arm lever 59 by rotation of the externally projecting knob 25 on the dial cam member 22. The driving pin 30' on the slide plate 30 rotated with the dial cam 22 engages a cooperating stud projecting from the lower face of the lowermost tumbler 47 to impart rotation to that tumbler in accordance with the rotation of the dial cam 22. Rotation is selectively imparted to the tumblers 48 and 49 through the fly washers and abutment studs associated with those tumblers in accordance with conventional practice.

When the combination has been established to position the tumbler recesses opposite the projection of the fence 68, the knob 25 is then rotated to bring the zero mark of the dial cam graduations on the surface 79 into alignment with a preselected index mark which disposes the deep portion of the driving cam gate 28 opposite the projection of the fence 68. The control spindle knob 37 coaxial with the knob 25 is then rotated independently of the knob 25 to rotate the tang 38 and, by its engagement with abutments on the slide plate recess 39', shift the slide plate 30 to expose the driving cam gate 28 to receive the fence. During this rotation of the control spindle 35 between its normal position and the position when the slide plate 30 is in gate-exposing position, the interlock pin 41 is projected into the socket 45 in the casing 11 to interlock the dial cam 22 against rotation relative to the casing.

When the tumbler recesses and the driving cam gate are all aligned and exposed to receive the fence 68, the fence is pivoted toward the axis of the tumblers under the action of its spring 70 to seat the fence nose in the peripheral notch 59' of the lever 59. Further manual rotation of the driving cam 23 rotates the fence 68 to shift the locking arm control lever 59 in a counterclockwise direction, as viewed in Figure 2, and move the ends of the locking arm 64 out of locking engagement with the locking recesses 66 and 67 in the shackle arms 16 and 17. As the tumbler recesses and the control lever notch 59' are, in accordance with conventional practice, somewhat larger than the fence nose 68' so as...
to be properly aligned to receive the fence nose 68' if the dial graduations are misaligned with the index mark by no more than one-half a graduation, the tumbler recesses and notches 59' are sufficiently large to accommodate the nose 68' during rotation of the fence 68 as described above. The shackle 15 can then be pulled outwardly from the casing 11 to the degree necessary to rotate the pin from a radius of 65 and, at the outer limit of its movement, the short leg 16 of the shackle can be shifted about the axis of the long leg 17 out of alignment with its socket 12.

When the shackle 15 is forced inwardly of the casing 11 to again seat the free end of the short shackle leg 16 within its socket 12, and the knob 25 is rotated to shift the dial cam 22 in a counterclockwise direction, as viewed in Figure 5, the fence 68 is returned to its initial position which, due to the interlocking of the fence projection into the complementary recess 59' in the adjacent edge of the locking control lever 59, returns the locking arm 64 into a position disposing its ends in locking relation in the locking recesses 66 and 67. Then, upon rotation of the control spindle knob 37 to return the slide plate 30 to its gate-closing position, the lock is completely relocked.

A modification of this construction which involves a substantial simplification of the components and elimination of the water-proofing features is illustrated in Figures 7-10, inclusive. In this embodiment, the padlock casing, indicated by the reference character 111, is of cylindrical formation through and through and is provided with a pair of sockets 112 and 113 in the top cover member 114 from which the U-shaped shackle 115 projects. The shackle 115, as in the previously described embodiment, is provided with a short leg 116 and a long leg 117 which are received in the sockets 112 and 113, respectively. The lower end wall of the casing 111 is provided with a pair of sockets 112 and 113 in the top cover member 114 from which the U-shaped shackle 115 projects. The shackle 115 is provided with a short leg 116 and a long leg 117 which are received in the sockets 112 and 113, respectively. The lower end wall of the casing 111 is provided with a pair of sockets 112 and 113 in the top cover member 114 from which the U-shaped shackle 115 projects.

The dial cam 123 is provided with a pair of guide blocks fixed in diametrically opposed relation thereon to support therebetween a slide plate 120 similar in construction and function to the guide plate 30 described in connection with the preceding embodiment. Within the axial bore 135 of the dial cam member 122 is positioned a control spindle 135 having a control knob 137 fixed on the end thereof and seated in a complementary recess 135' of the dial cam knob 125. The control spindle 135 and knob 137 are held in the recess 135' by means of a pin 125' projecting into an annular recess 137' in the knob 137, extending for 180 degrees about the periphery of the knob 137. On the opposite end of the control spindle 135 is a tang 138 cooperating with the aperture 130 in the slide 130 to shift the slide plate between blocking and exposing positions relative to the driving cam gate.

Projecting downwardly in coaxial relation with this control spindle 135 from the top cover member 114 is an integral tumbler post 133 on which are freely journaled the tumblers 147, 148 and 149, the tumblers being retained on the tumbler post by a split ring 150. A driving pin 130' projects upwardly from the slide plate 130 to be brought into contact with a conventional downwardly projecting driving stud on the lowermost tumbler 147, when the slide plate 130 is in driving cam gate-closing position, to achieve manual adjustment of the tumblers. A pivoted locking arm 160 having a locking shoulder 161 projecting at one radial direction from the tumbler post 133 to be engaged with the locking recess 167 of the long shackle leg 117 and an upwardly offset outside shoulder 162 on the lowermost tumbler 141 of the recess 160 of the short shackle leg 116 is freely journaled for rotation on the tumbler post 133 and is spaced from the uppermost tumbler 149 by means of a washer 163. A fence 168 which is mounted on a fence post 169 is resiliently biased by a spring 170 toward the axis of the tumblers and engages the outside of the peripheries of the tumblers 147, 148 and 149 and of the locking arm 160 to be received, when the combination is properly established, in the gates of the tumblers and in the peripheral notch 164 of the locking arm 160. The lock is so arranged that when the tumblers are properly adjusted to change the combination of the tumblers, the usual combination-changing key apertures in the tumblers, such as is indicated in 149' of Figure 9, are disposed immediately below, and in axial alignment with, a combination-changing key opening 114' in the top cover member 114 so that the combination-changing key, when the locking arm 160 is in unlocking position as illustrated in Figure 9, may be inserted through the socket 114' into the combination change key apertures in the tumblers. This aperture 114' is covered by the projection 165 when the locking arm 160 is in locking position.

The lock is provided with a dial 121 of the padlock casing 111 is provided at a selected radial position from the axis thereof with an arcuate opening 180 covered with a suitable transparent material and in alignment with the graduations 179 provided on the lower surface of the driving cam 123 by which the angular position of the dial 121 may be visually determined.

The operation of this modification is as follows: Assuming the lock to be in closed condition as illustrated in Figure 7, the dial knob 125 is manually manipulated a selected number of turns alternately in a counterclockwise and a clockwise direction in accordance with the combination established which, through the lost motion interconnection between the slide plate driving pin 139 and the lowermost tumbler 147, effects annular adjustment of the tumblers to bring the tumbler gates into position to receive the projection of the fence 168. The dial is then manipulated in a prescribed direction to align the zero calibration with an index mark on the casing, at which position the driving cam gate 128 is aligned to receive the fence 168, but is prevented from doing so by the slide plate 130. The control spindle knob 137 is then rotated through 180 degrees, as is permitted by the pin 125' which, through the interaction of the tang 138 and the slide plate recess 130', retracts the slide plate 130 to expose the driving cam gate to receive the fence 168 which then rotates into position in the aligned gates under the influence of its spring 178. Limited rotation of the knob 125 in a clockwise direction, as viewed in Figure 8, then pivots the fence 168 in a counterclockwise direction about its post 169 and through its operative engagement with the locking arm notch 164, pivots the locking arm about the tumbler post 133 to free the shoulders 161 and 162 thereof from the locking recesses 160 and 167 of the shackle 115. The depth and width of the driving cam gate 128, the tumbler gates and the locking arm notch 164, are, of course, sufficient to accommodate rotation of the fence 168 about its post as described above. The end of the short leg 116 of the shackle may then be freed from the socket 112 through the limited axial movement of the long leg 117 permitted in the socket 113 by the recess 156 and retaining pin 155, and the shackle may be rotated about the axis of the leg 117 when it is withdrawn to its outermost position.

To close the lock, the shackle leg 116 is rotated into
alignment with its socket 112 and is shifted inwardly to the inner limit of travel permitted by the retaining pin 155, and the dial knob 125 is rotated in a counterclockwise direction, as viewed in Figure 8, to return the tumblers 140 and 141 in their positions illustrated in Figure 8, thereby interlocking the locking arm 160 with the locking recesses 166, 167 of the shackle 115. Upon rotation of the control spindle knob 137 to return the slide plate 130 to its normal gate-closing position, the unit is placed in normal locked condition.

It will be evident that any means provided to limit the extent to which the dials and driving cams of the above described embodiments may be rotated when the slide plates 30 and 130 are projected into gate exposing position, as the shifting of the driving pins on the slide plates to a position where the same will not engage the driven studs of the lowermost tumblers 47 when the slides occupy such projected position prevents any manual adjustment of the tumblers. If desired, however, abutment stops as disclosed in my above-mentioned patent and copending application may be employed in the path of movement of the projected slide plates to confine the permissible extent of rotation of the driving cams when the slide plates are so projected.

While only two preferred embodiments of the invention have been particularly shown and described, it is apparent that various modifications may be made in the invention without departing from the spirit and scope thereof, including providing a lost motion connection between said driving cam and tumblers, locking arm means pivotedly supported in longitudinally aligned spaced relation with said tumblers for rotation about said mechanism axis parallel to the axis of said casing, said mechanism axis being provided as an integral lever radiating from said mechanism axis and having a notch in the remote end thereof, and fence means pivotally supported on said casing and extending in parallelism with said mechanism axis adjacent the peripheries of said driving cam and tumblers and the notched end of said locking arm lever to be operatively engaged with said driving cam and said locking arm lever notch when said tumblers are in preselected alignment therewith to rotate said locking arm means to and from locking engagement with said shackle legs.

3. A combination padlock comprising a generally cylindrical casing having opposite end walls, a U-shaped shackle projecting from the upper end wall of said casing having one leg thereof slidably retained in said casing, said upper end wall having sockets for receiving the legs of said shackle, a dial member supported internally of said casing adjacent the lower end thereof for rotation about a mechanism axis parallel to the axis of said casing, said dial member having an integral driving cam portion at the upper end thereof having a peripheral gate therein and an integral knob projecting from the lower end thereof, a plurality of peripherally notched tumblers, means supporting said tumblers in longitudinally aligned coaxial relation with said driving cam portion of said dial member within said casing for rotation about said mechanism axis, means providing a lost motion connection between said driving cam and tumblers, locking arm means pivotedly supported in longitudinally aligned spaced relation with said tumblers for rotation about said mechanism axis and out of locking engagement with the shackle legs, and fence means pivotally supported on said casing and extending in parallelism with said mechanism axis alongside the peripheries of said driving cam and tumblers and said locking arm means to be operatively engaged in driven rotation with said driving cam and in driven rotation with said locking arm means when said tumblers notches are in preselected alignment therewith for transferring torque of manual rotation of said driving cam member from said driving cam member to said locking arm means to rotate said locking arm means to and from locking engagement with said shackle legs upon rotation of said driving cam.
legs upon rotation of said driving cam, said dial member having dial graduations in a surface thereof extending around said mechanism axis, and said casing having an arcuate sight opening therein covered with transparent material and extending over a preselected sector of said dial graduations to permit observation of the angular position of said dial member.

5. A combination padlock comprising a generally cylindrical casing having opposite end walls, a U-shaped shackle projecting from the upper end wall of said casing having one leg thereof slidably retained in said casing, said upper end wall having sockets for receiving the legs of said shackle, a dial member supported internally of said casing adjacent the lower end thereof for rotation about a mechanism axis parallel to the axis of said casing, said dial member having an integral driving cam portion at the upper end thereof having a peripheral gate therein and an integral knob projecting from the lower end of said dial member through the lower wall of said casing, a plurality of peripherally notched tumbler, means supporting said tumbler in longitudinally aligned coaxial relation with said driving cam portion of said dial member within said casing for rotation about said mechanism axis, means providing a lost motion connection between said driving cam and tumbler, locking arm means pivotally supported in longitudinally aligned spaced relation with said tumbler for rotation about said mechanism axis into and out of locking engagement with said shackle legs, said driving cam gate having a notch in the remote end thereof, fence means pivotally supported on said casing and extending in parallelism with said mechanism axis adjacent the peripheries of said driving cam and tumbler and the notched end of said locking arm lever to be operatively engaged with said driving cam gate and said locking arm lever notch when said tumbler notches are in preselected alignment therewith to rotate said locking arm means to and from locking engagement with said shackle legs upon rotation of said driving cam, said dial member having a truncated conical surface portion inclined to said mechanism axis and bearing dial graduations thereon, and said casing having downwardly converging wall portions in the region adjacent said graduations and an arcuate sight opening therein covered with transparent material extending over a sector of said graduations to render said graduations visible laterally of said casing.

6. In a combination padlock, the combination recited in claim 3, wherein said driving cam portion of said dial member is provided with a diametrically reciprocable slide plate mounted thereon for normally shielding said driving cam gate against entrance of said fence thereon, said dial member having a bore extending therethrough concentric with said mechanism axis, a spindle rotatably supported in said bore having tang means on the inner end thereof operatively engaged with said slide plate to shift said slide plate from driving cam gate-shielding position to driving cam gate-exposing position upon rotation of said driving cam through a preselected arc and the outer end of said spindle having a knob thereon projecting through the lower end of said knob, longitudinally shiftable pin means supported radially in said dial member, and said casing having a bearing surface surrounding the path of travel of said pin and an inwardly facing socket disposed to receive said pin in one angular position of said dial member, and an eccentric cam on said spindle for projecting said pin into said casing to prevent interlocking said dial member and casing against relative rotation during rotation of said spindle to shift said slide plate between gate-shielding and gate-exposing positions, and said bearing surface cooperating with said pin to retain said pin in a position relative to said casing preventing slide plate retraction movement of said spindle when said pin is out of alignment with said socket.

9. In a combination padlock, the combination recited in claim 5, wherein said driving cam portion of said dial member is provided with a diametrically reciprocable slide plate mounted thereon for normally shielding said driving cam gate against entrance of said fence thereon, said dial member having a bore extending therethrough concentric with said mechanism axis, a spindle rotatably supported in said bore having tang means on the inner end thereof operatively engaged with said slide plate to shift said slide plate from driving cam gate-shielding position to driving cam gate-exposing position upon rotation of said driving cam through a preselected arc and the outer end of said spindle having a knob thereon projecting through the lower end of said knob, longitudinally shiftable pin means supported radially in said dial member, and said casing having a bearing surface surrounding the path of travel of said pin and an inwardly facing socket disposed to receive said pin in one angular position of said dial member, and an eccentric cam on said spindle for projecting said pin into said casing to prevent interlocking said dial member and casing against relative rotation during rotation of said spindle.
ture into said tumbler combination-changing key apertures in alignment therewith, and a cap screw is removably threaded in said casing aperture to be exposed for removal from said casing aperture through said socket only when said shackle is in unlocked position with said shackle lug tilted out of alignment with said socket.

12. In a combination padlock the combination recited in claim 3, wherein moisture sealing gasket means are provided in surrounding relation.