May 22, 1951 C. A. LEONARD 2,554,111

MAGNETIC ELECTRIC IRON

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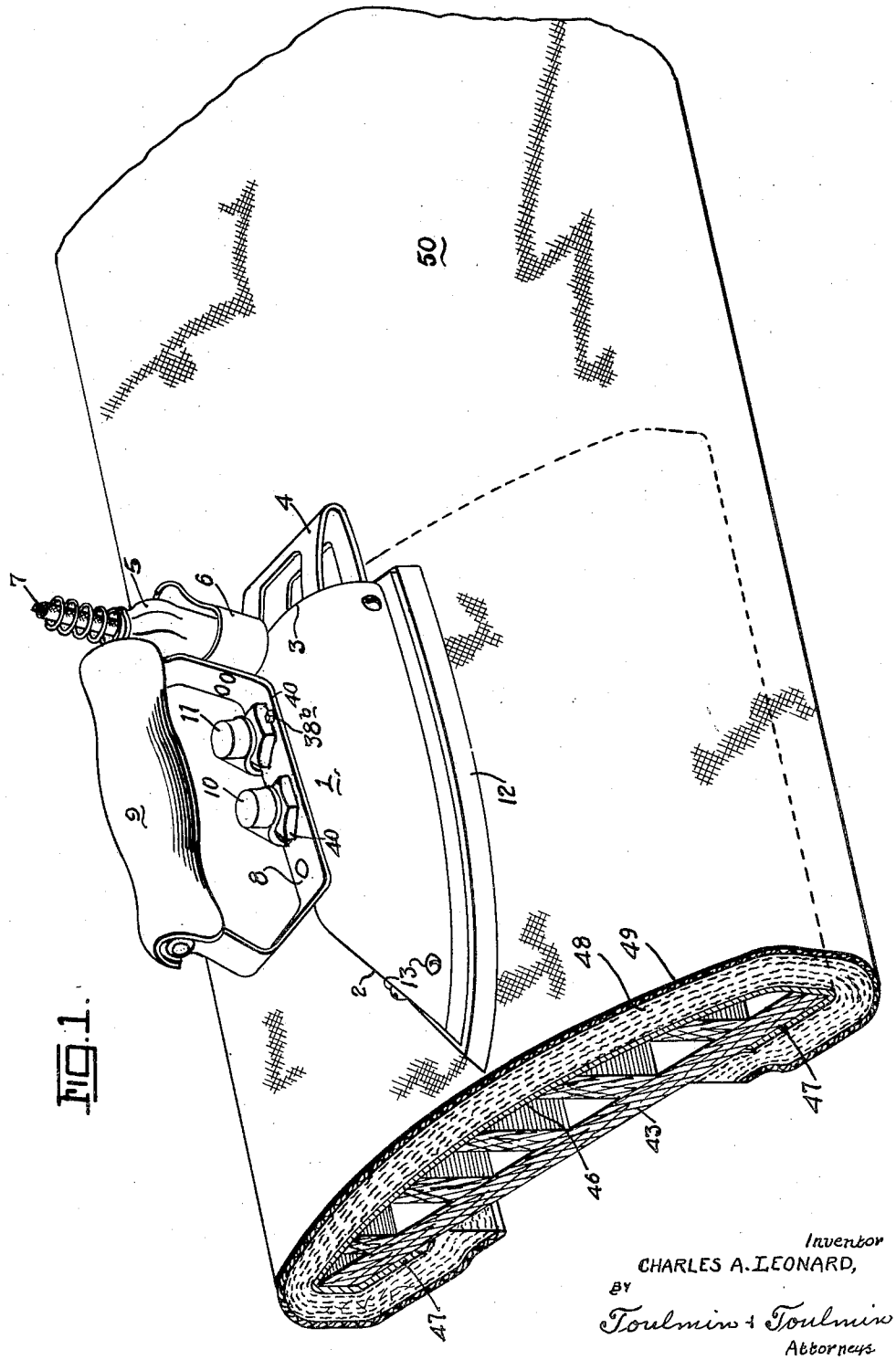


FIG. 1.

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FIG. 2.

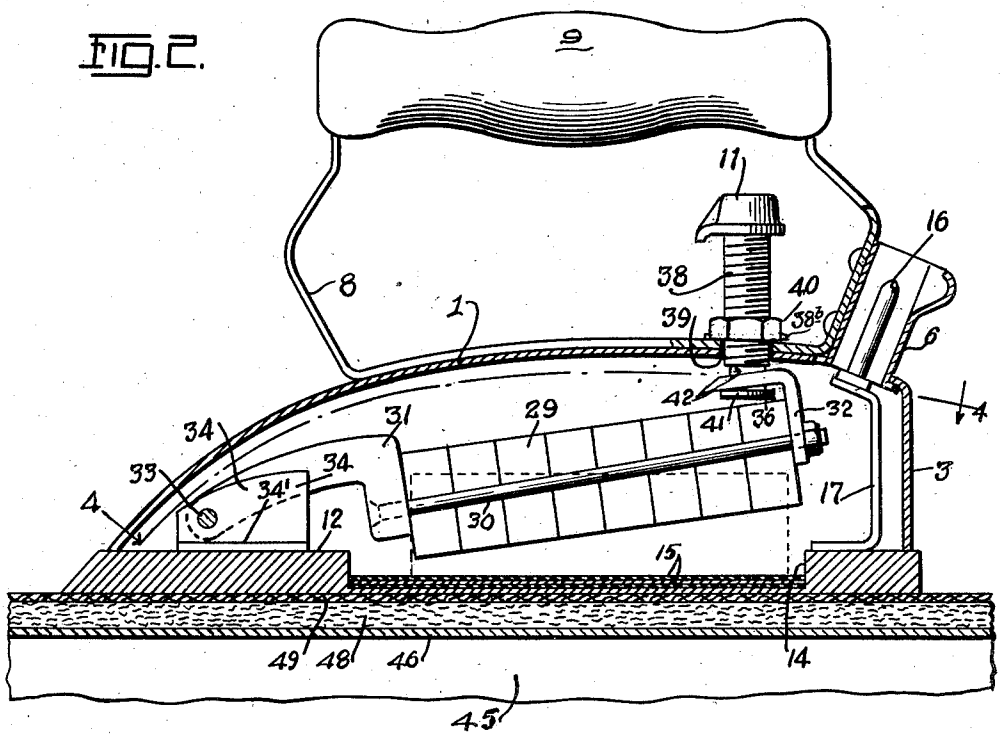
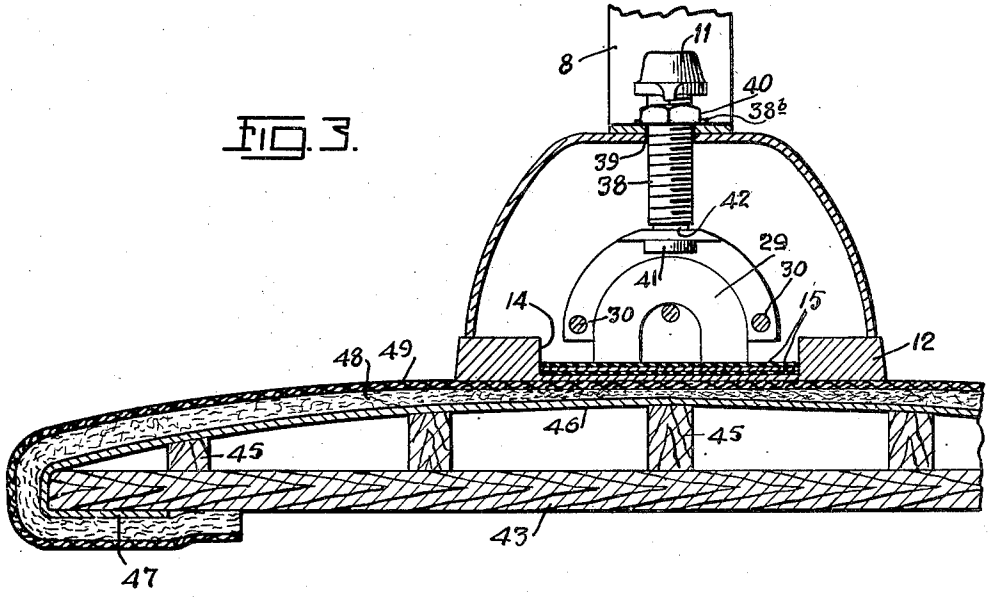


FIG. 3.



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FIG. 4.

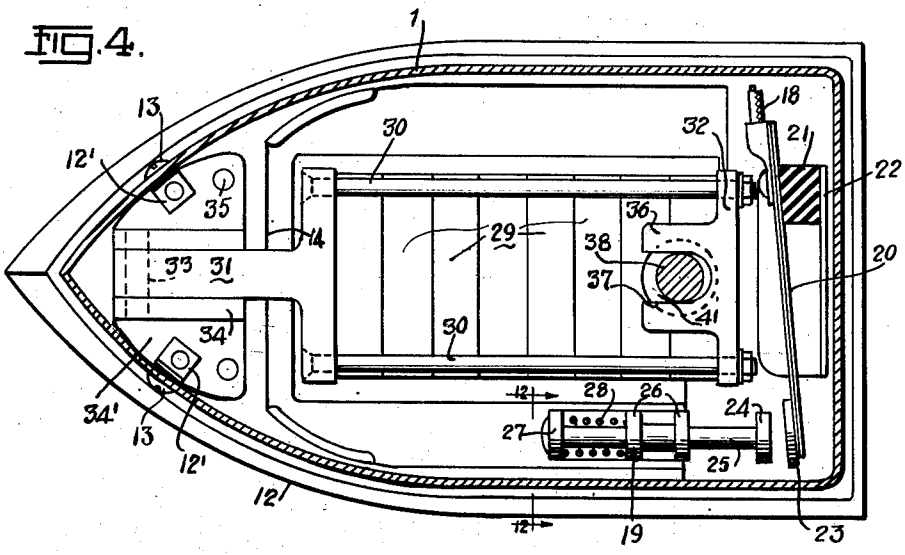


FIG. 5.

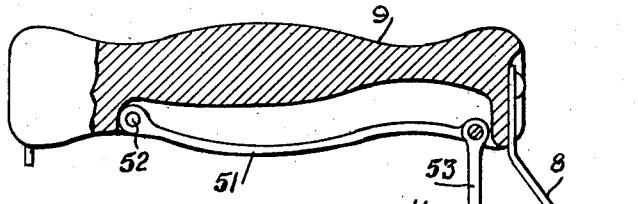
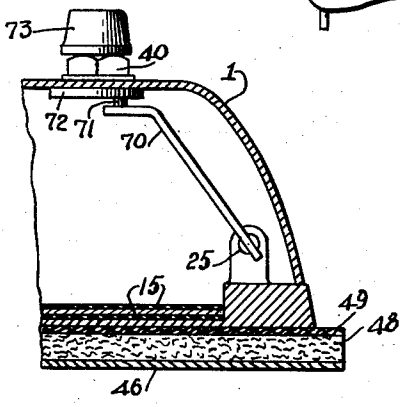


FIG. 6.



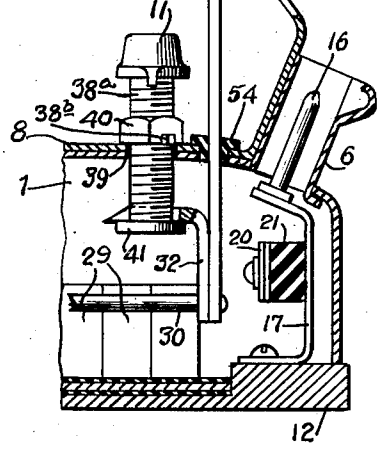
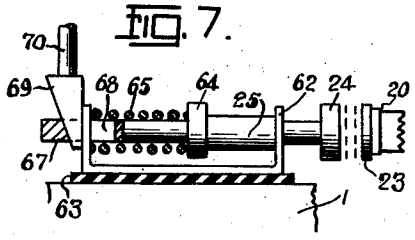


FIG. 7.



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FIG. 8.

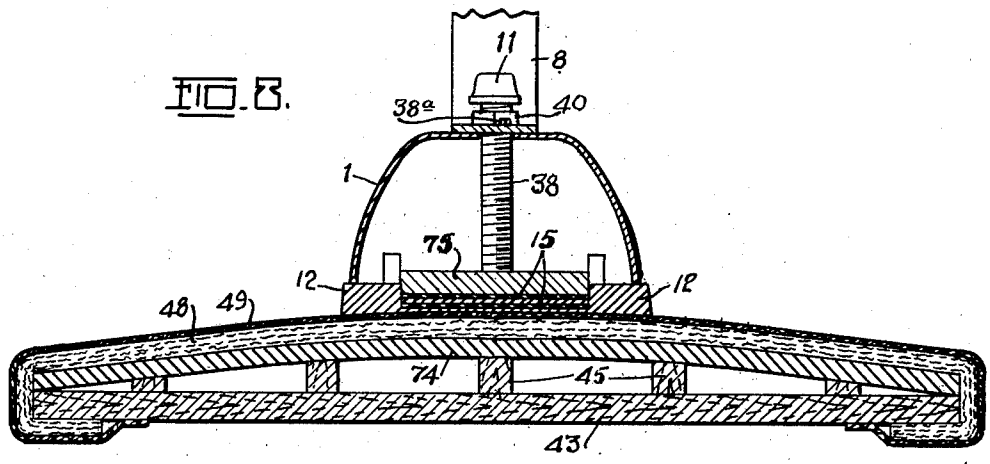


FIG. 9.

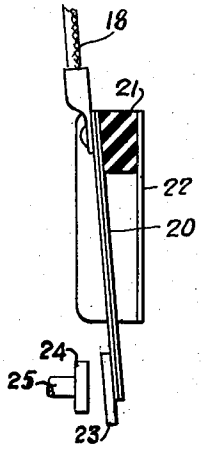


FIG. 10.

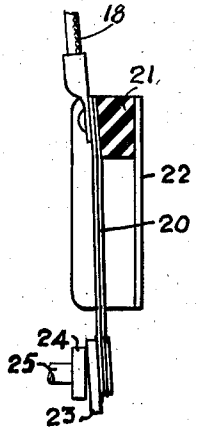


FIG. 11.

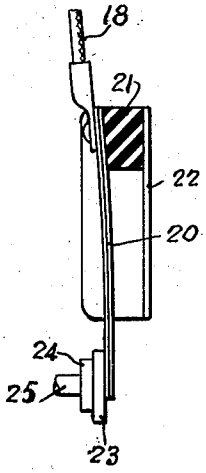
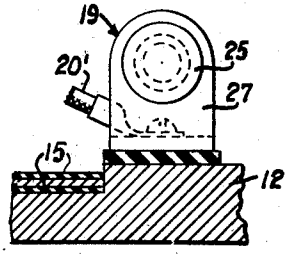


FIG. 12.



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MAGNETIC ELECTRIC IRON

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FIG. 13.

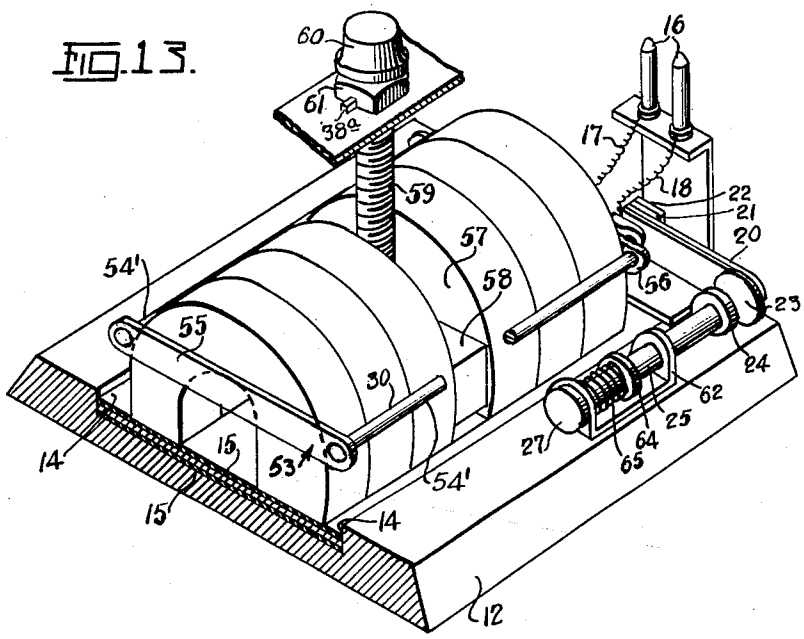


FIG. 14.

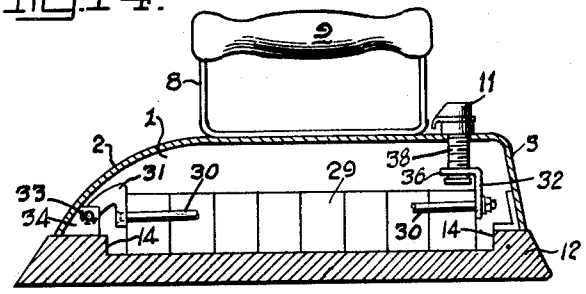
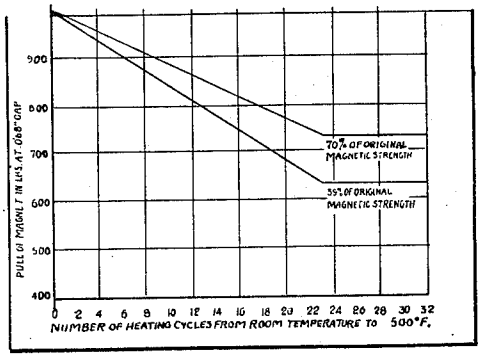


FIG. 15.



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UNITED STATES PATENT OFFICE

2,554,111

MAGNETIC ELECTRIC IRON

Charles A. Leonard, Cincinnati, Ohio

Application July 16, 1945, Serial No. 605,223

5 Claims. (Cl. 38—75)

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The present invention relates to pressing irons, gas or electric, but more particularly to the electric form of iron which carries a heating coil within the body.

Electric irons and also the smaller type of gas iron usually weigh in the neighborhood of seven to twelve pounds and in order to produce a smooth pressing job, it is sometimes necessary to bear down quite heavily on the iron. This may entail exhaustive work. On the other hand, if poundage is added to the iron by increasing the amount of metal contained therein in order to reduce the pressure necessary to be exerted by the operator, the iron becomes heavy to carry and also unwieldy.

The primary object of the invention is to provide an improved iron, gas or electric, which produces a strong attractive effort against the material being ironed but this effort is relieved or reduced when the iron is being brought into or out of operative position.

Another object is to provide an iron which will provide a strong pressing pull when the iron is resting in a particular region on the ironing board but when moved out of that region the attractive pull of the iron is materially reduced.

Still another object is to provide an iron, gas or electric, whose apparent weight is substantially increased while the unit is being operated but reverts to its ordinary weight when not being used.

Another object is to provide an iron, gas or electric, in which its apparent weight can be changed or adjusted in order to facilitate the ironing operation.

A further object is to increase the attractive force or pull by which an iron is held to the ironing board, which increase of attraction or pull is automatically reduced when the iron is about to be removed from the ironing board.

Still another object is to provide an iron of simple and inexpensive design which may be made in the form of a metal shell, hollow on its interior but yet will exert a pressing pull against the ironing board which is comparable to that offered by a fully weighted iron.

The above objects are obtained in brief by providing within the shell of the iron a plurality of specially refined and treated permanent magnets which cooperate through the bottom plate of the iron with a cover of magnetic material on the ironing board so that a strong magnetic attraction is offered between the iron and the cover. The permanent magnets are nested in a rockable cradle, the position of which can be controlled

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from the exterior of the iron to change the air gap between the magnets within the iron and the iron plate on the board. There is also provided mechanism by which the air gap between the magnets and the ironing board plate is substantially increased by pulling up on a lever positioned in the handle of the iron, thus simulating the removal of the iron from its ironing position. This lengthening of the air gap caused in this manner serves to weaken the magnetic pull exerted by the iron on the ironing board plate and therefore readily permits the iron to be removed from the plate. There is also provided in carrying out the above objects a mechanism by which the field of the permanent magnets can be shunted in any adjustable manner, thus again to control the pressing effort of the iron against its board.

The invention will be better understood when reference is made to the following description and accompanying drawings, in which:

Figure 1 represents a perspective view of the improved iron, and an ironing board having a special construction as to cooperate with the iron.

Figure 2 is a vertical sectional view of the iron and of a portion of the ironing board to show the internal arrangement of the parts.

Figure 3 is also a vertical sectional view but taken at right angles to the view shown in Fig. 2. A different sectional portion of the ironing board is also depicted in this figure from that shown in Figure 2.

Figure 4 is a transverse sectional view taken along line 4—4 in Figure 2 and looking in the direction of the arrows.

Figure 5 is a fragmentary vertical sectional view of a modified form of iron, particularly showing the manner in which the air gap at the magnetic circuit is automatically increased when the iron is being lifted away from the ironing board.

Figures 6 and 7 represent small sectional views taken in the vertical plane at about the center of the iron to illustrate a convenient manner in which the temperatures at which the iron will cut in and cut out may be readily controlled.

Figure 8 represents a transverse sectional view taken across a modified form of iron which cooperates with a modified type of ironing board.

Figures 9, 10 and 11 represent different stages of the contact making mechanism employing a bimetallic strip by which the circuit through the iron is opened or closed in response to changes of temperature.

Figure 12 is a small fragmentary sectional view

taken along line 12—12 in Figure 4, looking in the direction of the arrows.

Figure 13 shows partly in perspective and partly in section a modified form of iron containing the improved magnetic pressing pull devices and in which this pull can be readily controlled from the exterior of the iron without affecting the position of the magnets.

Figure 14 shows the application of my invention to a so-called gas iron, while Figure 15 is a graph which indicates the effective pull of the permanent magnets employed in the iron and particularly the manner in which this pull remains effective even under a cyclic period of heating and cooling within the temperature ranges normally employed in electric irons.

Referring more particularly to Figures 1, 2 and 4, reference character 1 designates a hollow metal shell forming the body of the iron. The shell has a curvilinear top surface which tapers to a bow 2 at its front and while the rear end terminates abruptly, as indicated at 3. A sheet metal support 4 may be provided for permitting the iron to be readily stood-up on end, as is well known in the art. A plug 5 may be received by a plug holder 6 for applying electric voltage to the heater within the iron through the cable 7. A strap 8 is riveted or otherwise secured to the top of the iron, this strap being adapted to receive between its ends a handle 9. There is a pair of rotatable knobs 10, 11 resting on the flat portion of the strap 8, the purpose of knob 10 being to adjust the temperature point at which the circuit making switch cuts in or out. The knob 11 provides a convenient method of adjusting the air gap between the array of permanent magnets within the iron and the iron plates provided on the associated ironing board.

The casing or body 1 of the iron and also the strap 8 and the vertical support member 4 are preferably made of non-magnetic metals for reasons which will appear presently.

The base 12 of the iron may comprise a heavy plate of non-magnetic metal, as shown more clearly in Fig. 3, tapered to a shape corresponding to the body 1 and upright angular pieces 12' are provided on the base member for receiving the shanks of the screws 13 by which the body of the iron is detachably secured to its base.

The base is provided with a countersunk or depressed portion or well 14 (Figs. 2 and 3) for receiving the heating unit which will be described presently and also a plurality of fixed magnets. The electrical heating unit may be of any suitable and well-known construction and usually comprising a plurality of turns of wire insulated from one another and contained between sheets of mica or asbestos, indicated at 15, in order thoroughly to insulate the wire from the metal base. At the rear of the iron there is provided a pair of metal plugs 16 contained within the plug holder 6 (Fig. 1) and adapted to be received by a pair of sockets carried by the composition plug member 5, one of the plugs 16 or contacts connected through a wire 17 to one end of the heating coil. The other contact 16 is connected through a wire 18 through a temperature responsive mechanism including a bimetallic strip 20. A wire 20' is connected between the switch mechanism and the other end of the heating coil (Fig. 12). The bimetallic strip 20 is insulatingly supported, as indicated at 21, from an upright 22. The contact pins 16 are insulatingly mounted in any suitable manner on the upright 22. At the end of the bimetallic strip opposite

from the cable end there is a relatively large disc 23 which forms a wiping contact with the disc 24 during the circuit closing operation. The latter member is carried on a rod 25 which is slidably received by a pair of uprights 26 (Fig. 4). A collar 27 is secured to the opposite end of the rod 25 and a compression spring 28 is inserted between one of the uprights 26 and the collar 27, surrounding the rod 25. The purpose of this spring is to provide a yielding effect to the contact member 24 when the contact 23 is caused to strike against it during flexure of the strip 20. Thus, when the interior of the iron cools below a predetermined temperature which is set by the design of the switch the strip 20 tends to flex inwardly and to start a wiping contact with the element 24 and on continued flexure of the strip members 23, 24 come firmly into contact with one another at the termination of a complete wiping action. This effect has been illustratively indicated in Figures 9, 10 and 11, Fig. 10 showing the start of the wiping contact effect and Fig. 11 shows the two contacts in abutting relation over their entire contacting surfaces.

Upon the interior of the iron reaching a predetermined temperature, the bimetallic strip will flex outwardly and a further wiping function will be obtained but in the reverse order from that in which the contact was established. Thus, the bimetallic strip 20 serves to make and break the contact at the elements 23, 24, depending on a minimum and maximum temperature being derived within the iron by the heating effects at the coil. It is apparent that the spring 28 permits the contact member 24 to give a little when the bimetallic strip causes the member 23 to make its first contact with the disc 24. This yielding effect also enhances the wiping action between the two contacts during the making and breaking cycles. The iron as explained up to this point is of conventional design and it has been found that when using such an iron for pressing work it may become necessary to apply the weight of the operator to the iron in order to obtain the desired pressing effect, for example, a sharp crease in trousers. If the pressing operation is conducted over any appreciable period of time the need for this downward pressure exercised by the hand of the operator on the handle 9 may become exhaustive. In accordance with one of the main objects of the invention, I replace the downward push or pull exercised by the operator under these circumstances by a magnetic pull or attraction. For this purpose, a plurality of permanent magnets preferably made of Alnico (indicated at 29) are employed. These magnets may conveniently take a horseshoe shape and are held together within a frame work formed of two longitudinally extending rods 30 having an upset head at one end which is received by a lever member 31 and at the other end is bolted to a bracket 32. The lever 31 has an L-shape and the longer leg is given a slightly arcuate configuration. The lever is pivoted, as indicated at 33, between a pair of upstanding plates 34 which are integrally adjoined to a plate piece 34'. The latter is riveted, as indicated at 35, to the base member 12 of the iron. Thus, the frame containing the magnets 29 is adapted to move through a limited angle in the vertical plane about the pivot 33, as can be seen in Fig. 2.

The bracket 32 has a horizontally extending portion 36 which is provided with a slot 37. There is a screw 38 directly above the slot and loosely received by an opening 39 in the casing 1 of the

iron. A nut 40 is threaded on the screw and its purpose is to regulate the depth that the screw is permitted to enter the interior of the iron. The screw 38 terminates at the top in the adjusting knob 11 referred to hereinbefore, and at the bottom is provided with an enlarged disc-like head 41 which is separated from the threaded portion by a neck 42. This neck is adapted to be received by the slot 37 of the bracket 32 so that by turning the knob 11 the height of the bracket 32 within the iron may be adjusted, carrying with it the frame and nested permanent magnets. Thus, any angularity can be given to the magnet group, in fact, the knob 11 may be turned such an extent as to permit the magnet unit to rest over its entire length on the insulated heating element, as is indicated by the dot-dash lines in Fig. 2. In order to prevent the nut 40 from turning when the knob 11 is rotated, the nut may be provided with a groove extending across its lower face which cooperates with an upwardly extending tongue formed on the casing of the iron, or on the upper surface of the strap 8.

The iron shown in Figs. 1 to 4 requires an ironing board which includes an iron or steel plate for cooperating with the magnets 29 in providing a strong magnetic pull between the iron and the board. As shown in Fig. 1, the board may include a wooden base 43 having a plurality of equidistantly spaced wooden uprights 45 extending thereover. An iron or steel plate 46 capable of reacting strongly with the magnetic lines of force is supported on the tops of the wooden uprights and bent around the outer edges of the base 43 and terminating in plate portions 47 along the lower surface of the base. This iron plate can be screwed or otherwise secured to the wooden frame. There is an ironing pad 48 of any suitable and well-known character fitted around the iron plate 46 and secured to the frame 43 and directly on top of the pad a layer of relatively hard textile material such as muslin 49 may be applied. As indicated in Fig. 1, the iron plate 46 extends along only a limited portion of the board so as to leave a so-called "dead" space, indicated at 50 which offers no magnetic reaction to the permanent magnets 29.

The ironing board as a whole has an arcuate configuration considered in a transverse or width direction, this shape providing the advantage of permitting the muslin to be drawn taut over the entire width of the board, thus avoiding iron wrinkles, and in addition, effects a concentration of magnetic lines of force over a limited width of the iron which tends to increase the magnetic pull. The last-mentioned effect can be seen from an inspection of Fig. 3 which shows that the distance between the oppositely disposed poles of the permanent magnets 29 and the upper surface of the arcuately formed iron plate 46 is considerably less than the distance between the plate and the side edges of the iron. This decreasing of the length of the air gap increases the magnetic pull exercised by the permanent magnets on the iron plate.

It is apparent that an operator in using the improved iron and its board accessory would first adjust the knob 11 to give the proper amount of magnetic pull to the iron, depending on the character of the ironing being done and the personal preference of the operator. If the latter desires to remove the pull entirely from the iron, he simply moves the iron to the dead space 50. The knob 10 is, of course, adjusted at any time to give the proper current-on and current-off temperatures to the iron and in practice the knob may be replaced by a screw which might be permanently adjusted by the manufacturer.

It may be desirable to lift the iron away from that portion of the board which includes the metal plate and this may ordinarily represent a hard task, particularly if the magnets 29 had been adjusted so that they rest directly on the heating unit so that they offer a maximum pull or attraction.

A convenient way of releasing this magnetic pull temporarily upon lifting the iron away from the board is shown in Fig. 5. A lever 51 is pivotally mounted, as indicated at 52, to the underside of the handle 9, the handle being recessed to accommodate an upward pull on the lever. A connecting rod 53 is pivoted to the lever, this rod loosely extending through a bushing 54 and secured at a position within the iron to the lower portion of the member 32. The screw 38, instead of being provided with a necked down portion as was described in connection with Fig. 2, has a straight shank 38*a* which terminates in a large collar or head 41. The opening in the bracket 32 is sufficiently large loosely to receive the shank 38*a* but is of smaller diameter than the head 41, so that the bracket can rest on the head. The nut 40 may be provided with a diametrically extending groove at its bottom face, into which may extend a small upstanding tongue 38*b* on the casing in order to prevent the nut from turning with respect to the casing as the knob 11 is rotated.

Thus, by lifting up on the lever 51, as when the operator squeezes the handle 9 to remove the iron from the board, the rod 53 is caused to move upwardly and to carry with it the bracket 32 which slides loosely over the screw shank 38*a*. However, on releasing the lever 51 from the squeezed position the rod 53 drops downward and the bracket 32 again slides over the shank 38*a* until it strikes the upper surface of the head 41. This action determines the height at which the magnets 29 will come to rest above the base of the iron. Thus, it is possible by simply squeezing the handle 9 to temporarily elevate the magnets 29 to a considerable distance away from the base of the iron, thereby increasing the air gap to such an extent that little or no magnetomotive force will be developed between the magnets 29 and the cooperating iron plate in the ironing board.

The arrangement is therefore such that the position of the magnets 29 can be readily adjusted by the knob 11, giving the magnet unit as a whole any desired cant with respect to the base of the iron, and still permit the unit to be readily moved upwardly by means of the lever 51 to break the air gap. When the lever is released the magnets instantly drop of their own weight to a depth determined by the position of the screw 38*a*. It will be understood that instead of using a lever 51 and causing the magnets to be swung upwardly above the pivot 33, it may be convenient to move the iron to a dead portion of the board at which time the iron can be readily lifted.

Various other ways may be employed for releasing the pull of the magnets when it is desired to lift the iron directly away from that portion of the board which contains the iron plate. An alternative method and structure for doing this has been illustrated in Fig. 13 in which corresponding parts are represented by similar reference characters. In this figure, a plurality of permanent magnets, six as illustrated, are used

similar to those shown in the preceding figures and contained within a clamping frame, indicated generally at 53. This frame may comprise a pair of rods 54', headed at one end so as to be received by countersunk openings in a transversely extending leg 55 and threaded at the other end for bolting to another transversely extending leg 56. The magnets are divided into two groups with a space 57 therebetween and within this space there is a transversely extending iron bar 58 which is adapted to slide in a fairly snug fit in the vertical direction. A screw 59 threadedly engages the bar 58, this screw extending to the exterior of the casing of the iron and terminating in a knob 60. Thus, by rotating the knob, using a wrench on the hexagonal portions 61 if desired, the bar 58 may be caused to be moved upwardly or downwardly and thereby magnetically to short circuit any or all portions of the two sets of magnets. In the position shown, the bar will constitute practically a complete magnetic short circuit of at least the two magnets on each side of the bar and a partial short circuit for the remaining magnets since the bar in effect constitutes a keeper. As the bar is moved upwardly the magnetic short circuiting effect becomes less and less.

It is apparent that instead of using a short circuiting bar of rectangular shape which slides up and down the side surfaces of two adjacent magnets, I may provide bars of circular configuration which roll up and down any one or more surfaces of the magnets and controlled through a rack and pinion arrangement by the rotary knob 60. It is further apparent that while this magnetic short circuiting structure is highly useful in entirely cutting off or at least reducing the magnetic pull when the iron is about to be lifted from the board, the same device could be advantageously employed to control the permanent pulling effect of the magnets similar to that which was explained in connection with Fig. 2. The structure illustrated in Fig. 13 has the advantage over that shown in Fig. 2 in the respect of eliminating the necessity for the rocking frame 31 but would have the disadvantage of failing completely to remove the magnetic shunt from the magnets, so that there would always be a slight decrease in the pulling power of the magnets.

While I prefer to employ permanent magnets for effecting the pull between the iron and the iron plate of the ironing board, electromagnets may also be used to advantage although in general the permanent magnets provide a much simpler and more compact method of producing the magnetic pull. After exhaustive research and development, I have found that the use of Alnico permanent magnets is entirely feasible for use in electric or gas irons, notwithstanding the intense heat developed under these circumstances and also taking into consideration the fact that irons, particularly electric irons, are heated and then allowed to cool many times during an ordinary ironing job.

Figure 15 shows a typical graph that has been obtained during the development work and it will be noted that the ordinate of the graph represents pull of an Alnico magnet in pounds while the abscissa is divided into the number of heating cycles from room temperature to 500° F. Notwithstanding the fact that a given magnet sample had been subjected to thirty-two heating and cooling cycles in which the temperature ranged from 500° F. to room temperature the magnet still retained 70% of its original magnetic strength. Still another sample magnet retained 59% of its original magnetic strength, showing that the use of permanent magnets within an iron which is heated in the neighborhood of 500° F., either electrically or on a gas stove, is entirely feasible.

It has already been explained that the iron preferably includes an automatic heat regulator 25, 26 so that the results of the tests as indicated by Fig. 15 represent practical conditions.

The fact that permanent magnets are practically insensitive to abnormal heating and cooling cycles permits these magnets to be incorporated in a gas iron and a unit of this type has been illustrated in Figure 14. The magnets have been indicated as being depressed to their lowest position so as to rest directly on the base of the iron, although it will be understood, if desired, the magnet unit can be swung upwardly on rotating the knob 11 to obtain any amount of magnetic pull that may be desired.

In order to assure that the temperature of an electric iron containing the permanent magnets does not go appreciably above the safe operating temperature which is usually in the neighborhood of 500° F., I may provide mechanism controllable from the exterior of the iron for regulating the cut-in or cut-out of the switch elements 23, 24. A typical mechanism has been illustrated in Figs. 6 and 7 as applied to the thermostatically operating-yieldable contact arrangement, illustrated in Fig. 4. The mechanism shown in Figs. 6 and 7 in effect permits the horizontal adjustment of the rod 25 (Fig. 4) which in turn causes the contact disc 24 to approach or to recede from the opposite contact 23 and in this manner determines the amount of flexure of the bimetallic strip 20 that is necessary to make or break the contact. The rod 25 is slidably received by openings in a U-shaped frame member 62 which is insulatingly supported, as indicated at 63, on the base of the iron. A collar 64 is secured to the rod and a compression spring 65 surrounds the rod and is contained between one of the uprights of the frame 62 and the collar 64. The rod 25 is extended through the frame member to provide a portion 67 which contains a diametrically positioned wedge-shaped slot 68. This slot is adapted to receive a wedge-shaped bar 69 carried on the end of a diagonally extended connecting rod 70 (Fig. 6), the arrangement being such that as the rod 70 is pressed downwardly, the tapered edge of the wedge 69 will bear against the tapered surface of the slot 68 to cause the rod 25 to move to the left against the thrust exerted by the spring 65. Thus, the position of the contact member 24 in space is changed which in turn changes the temperature at which the switch kicks in or out when the bimetallic strip 20 is flexed.

For pressing the wedge member 69 downwardly through the connecting rod 70, a crank arrangement, indicated by the crank pin 71, is employed. This pin may be secured to a disc 72 which is carried on a shaft extending through the top of the casing 1 and terminating in a knob 73. Thus, by rotating this knob, the crank pin 71 will move through a small arc and will exert either an upward or downward movement on the connecting rod 70 which in turn moves the rod 25 either to the right or to the left to change the distance between the contacts. It will be understood that this temperature control arrangement for effect-

ing a change in the inter-contact distance represents a mere refinement of the invention in that it assures that the magnets 29 will never be subjected to excessively high temperature which might tend to reduce the magnetism contained therein. It will be understood that even in the absence of a temperature control device, the iron would still give a relatively long operating life, regardless of the temperature to which the permanent magnets might accidentally have been subjected so that the temperature responsive device merely serves to increase this operating life.

I have shown in Fig. 8 still another modification in which the permanent magnets are entirely eliminated from the iron but instead the plate 74 on the ironing board is made so thick that it can be readily magnetized. The iron in that event would be provided with a heavy iron plate 75 secured to the base of the iron in any suitable manner and this plate will cooperate with the heavy highly magnetized iron sheet of the board to provide the necessary pressing pull. It is apparent that if desired the plate 75 can be loosely mounted within the casing 1 and its position in the vertical direction controlled by means of a screw 38 and knob 11 similar to that described in connection with Fig. 2. If desired, the plate 75 could be eliminated in which case the base of the iron itself may be made of a metal which responds readily to a magnetic field. It will be noted that inasmuch as the metal plate 74 is given a concave or arcuate configuration, the same advantage would be obtained by way of concentrating the magnetic field at a position directly below the middle point of the iron as was explained in connection with Fig. 3.

From the foregoing it is evident that I have disclosed an improved iron, electric or gas heated, in which the pressing pull is increased enormously and at will by permanent magnets contained within the iron or a permanent magnet forming part of the ironing board. Consequently, the actual weight of the iron can be made considerably less than those on the market since the apparent weight introduced by the use of a permanent magnetic pull can be increased manyfold during the pressing operation. It will be further noted that in all of the aspects of the invention, the plate which cooperates with the permanent magnet or magnets in effect serves as a keeper or at least as a partial keeper, thus tending to retard the dissipation of the magnetomotive force which in turn assures long life to the permanent magnets. While it is my present intention that as the permanent magnets become weak over a long operating life they can be readily and inexpensively replaced by new magnets, nevertheless, it would be entirely feasible and within the contemplation of my invention to provide a magnetizing coil about the magnets so that they may be re-magnetized within the iron by simply energizing the coil with direct current.

It will be understood that I desire to comprehend within my invention such modifications as come within the scope of the claims and the invention.

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

1. A pressing iron comprising a casing and a base, a plurality of permanent magnets contained within the casing, said magnets being carried by a frame which is pivotally mounted on the base, and means positioned exterior of the casing for controlling the position of the magnet frame.

2. A pressing iron comprising a hollow casing and a nonmagnetic base therefor, a plurality of nested permanent magnets positioned within the casing and adapted to move together as a unit, pivot means in said frame supporting said magnets, and means positioned on the outside of the casing for adjusting the position of the magnetic unit toward and away from said base, and a heating coil within the casing positioned between the unit and the base.

3. A pressing iron comprising a casing and a base, a magnetic unit in said casing movably supported with respect to said base, a handle for the iron and a member movably mounted on said handle and connected with said unit and by which the magnetic unit can be moved with respect to the base when the handle is grasped and said member moved relative to the handle.

4. In combination a pressing iron and an ironing board, said iron comprising a hollow casing which contains a permanent magnet, said board including an iron plate which cooperates with said magnet in the iron for producing a magnetic pull, said iron plate extending over only a portion of said ironing board in order to provide a magnetic dead space.

5. A pressing iron comprising a casing and a base, a magnetic unit in said casing movably supported with respect to said base, a handle for the iron and a member movably mounted on said handle and connected with said unit and by which the magnetic unit can be moved with respect to the base when the handle is grasped and said member moved relative to the handle, and means adjustable on said casing for predetermining at least one of the limits of movement of said unit.

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