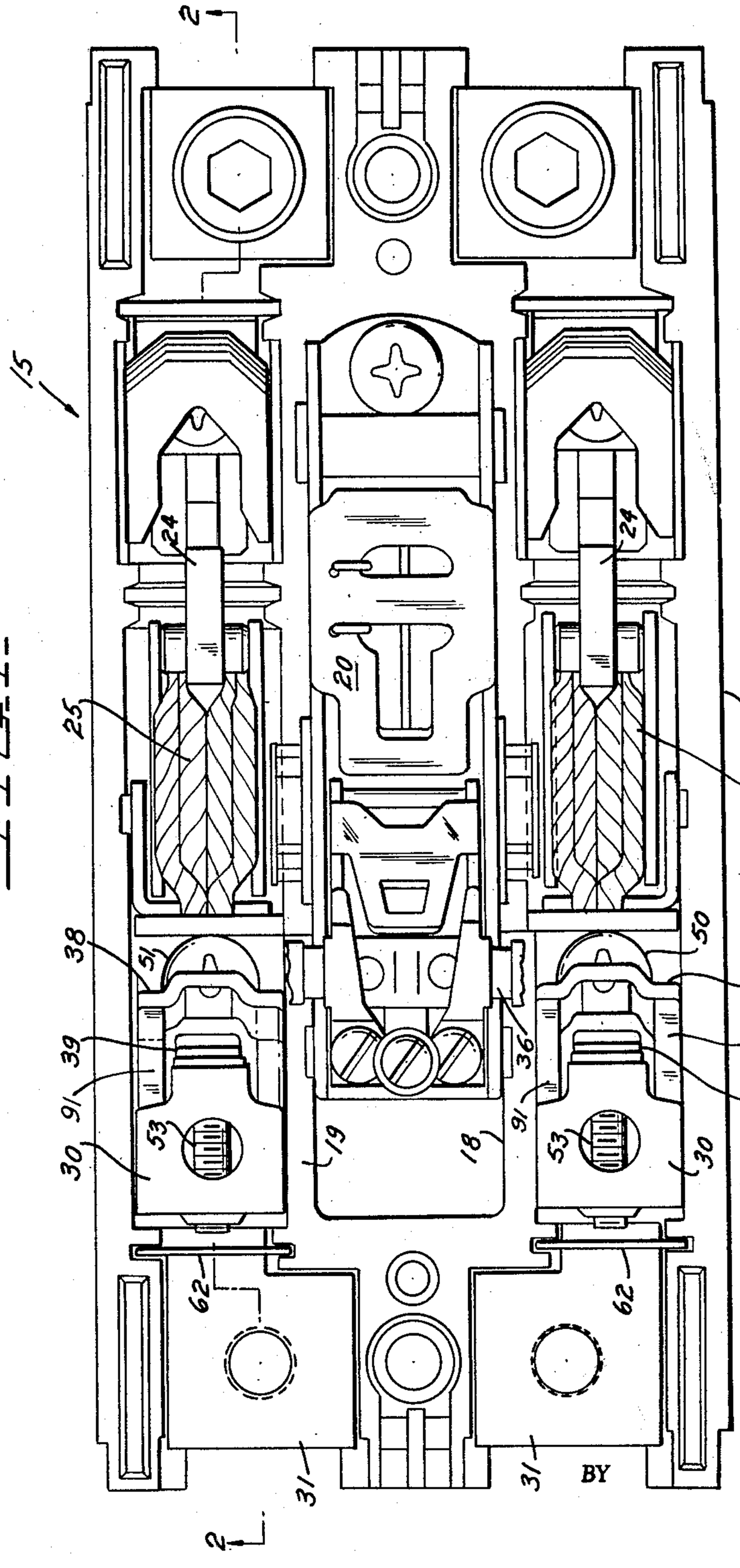
April 27, 1965 M. V. ZUBATY 3,180,953

AUTOMATIC TRIP DEVICE

Filed Feb. 19, 1962 4 Sheets-Sheet 1

FIG. 1



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AUTOMATIC TRIP DEVICE

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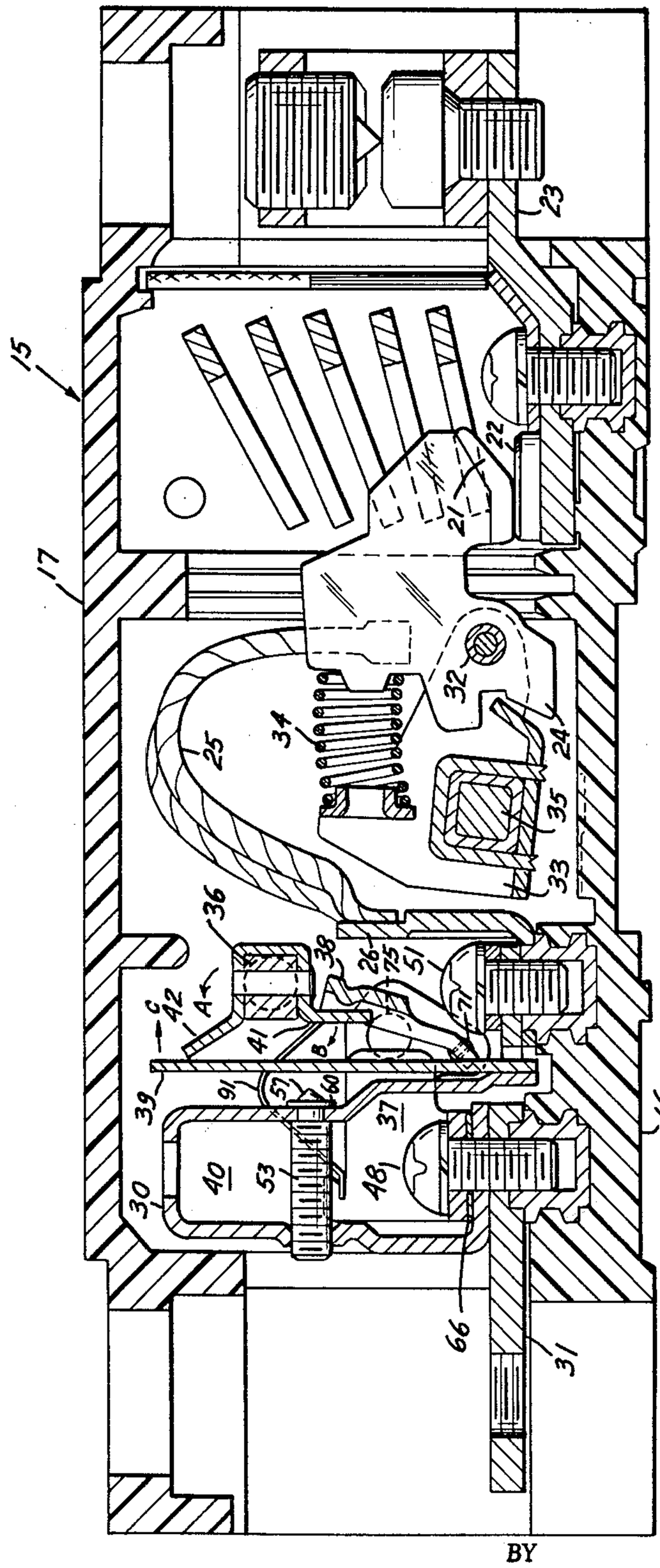
FIG. 2.



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AUTOMATIC TRIP DEVICE

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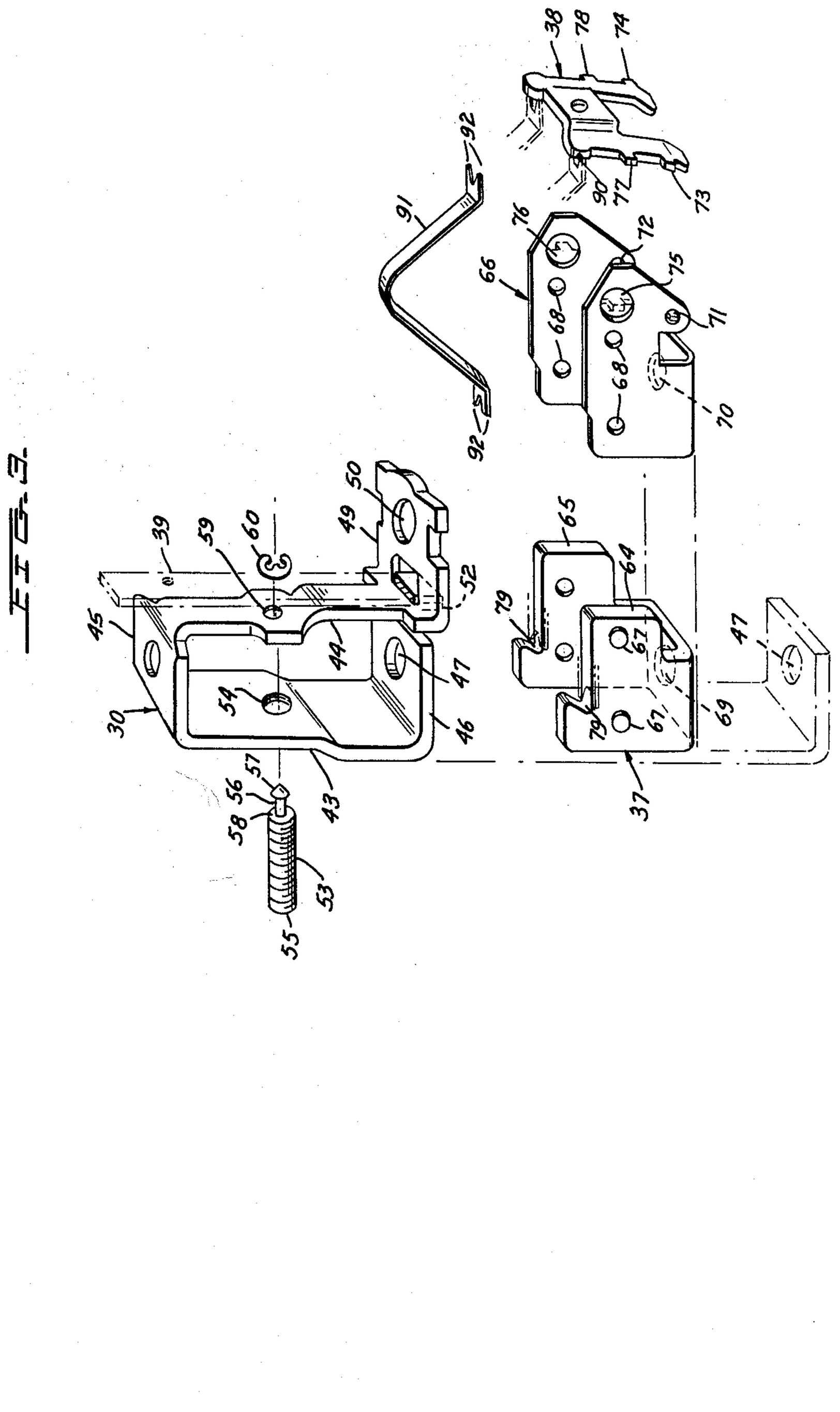
FIG. 3.



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AUTOMATIC TRIP DEVICE

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FIG. 6.

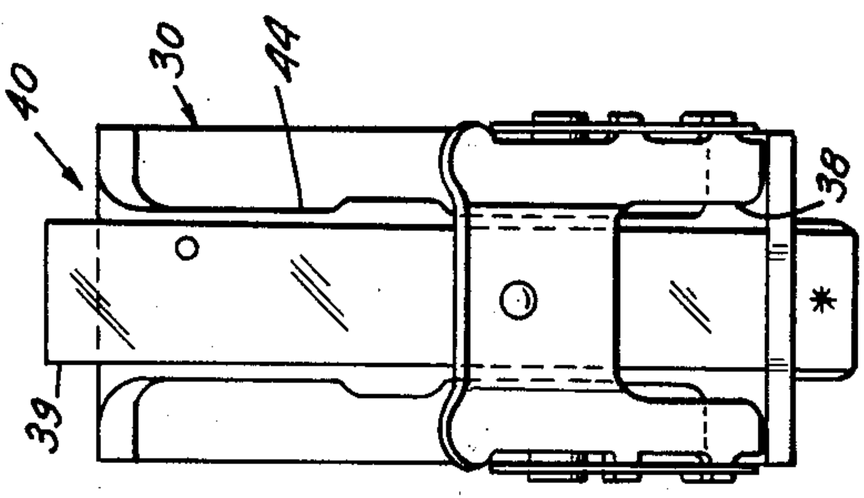


FIG. 8.

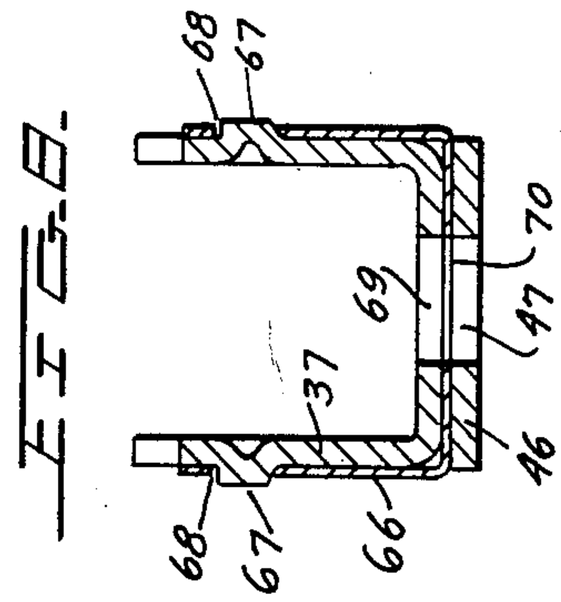


FIG. 4.

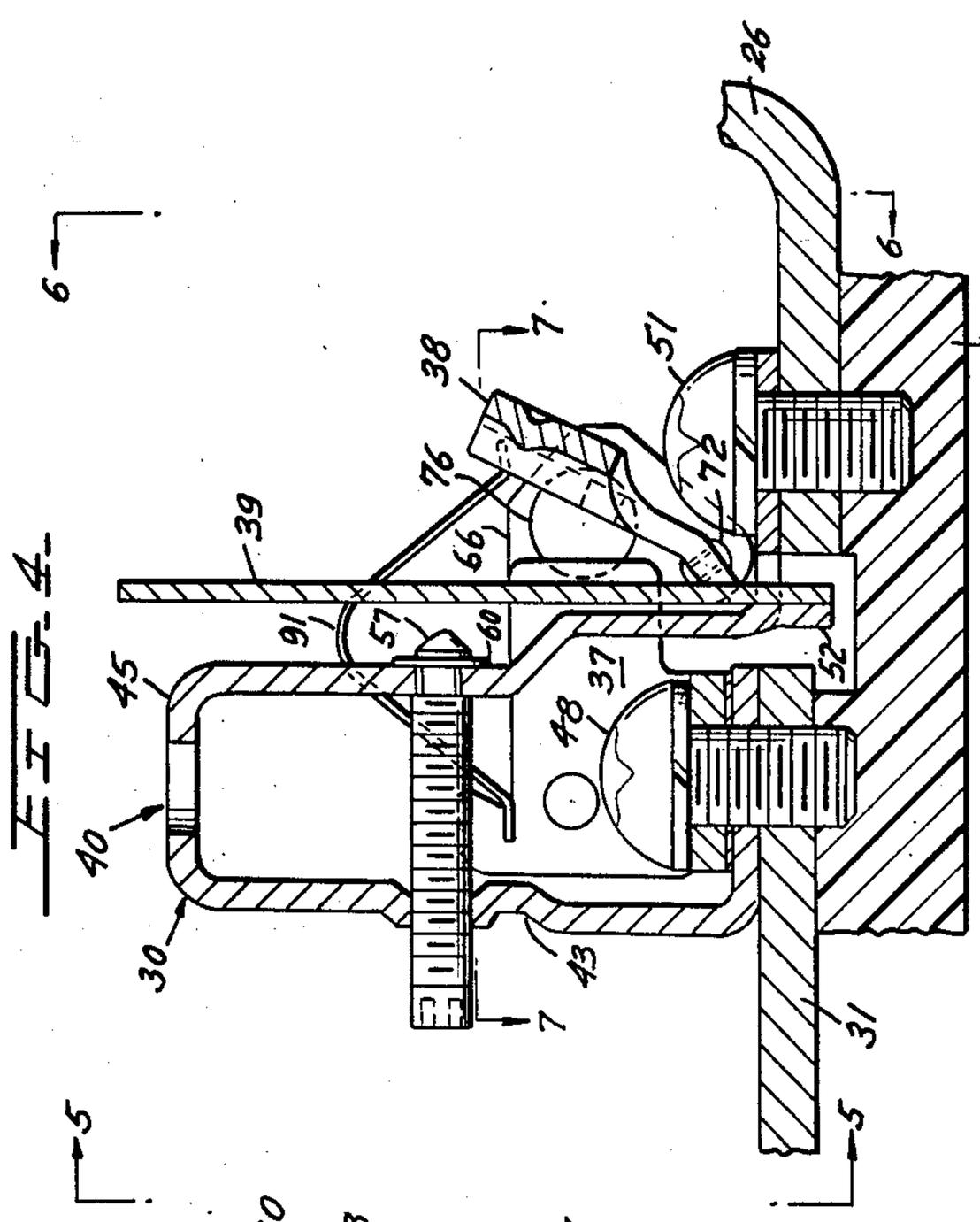


FIG. 7.

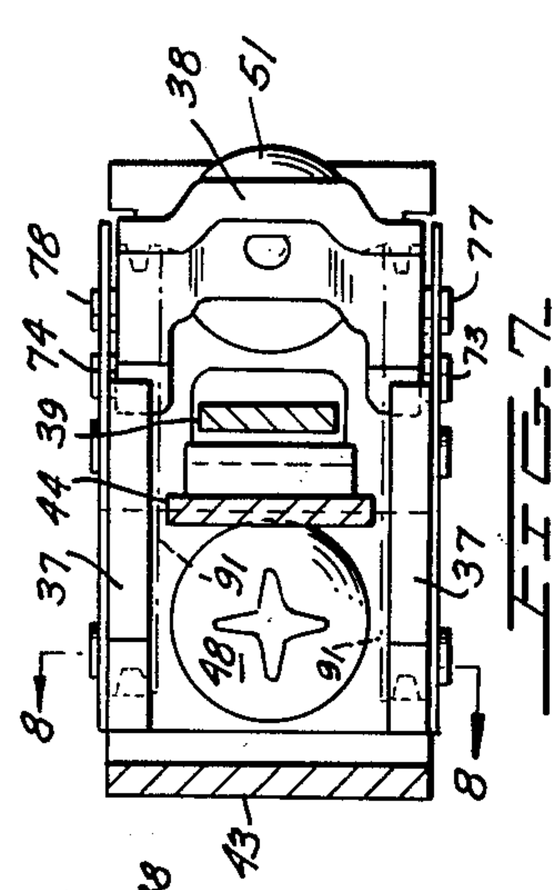


FIG. 5.

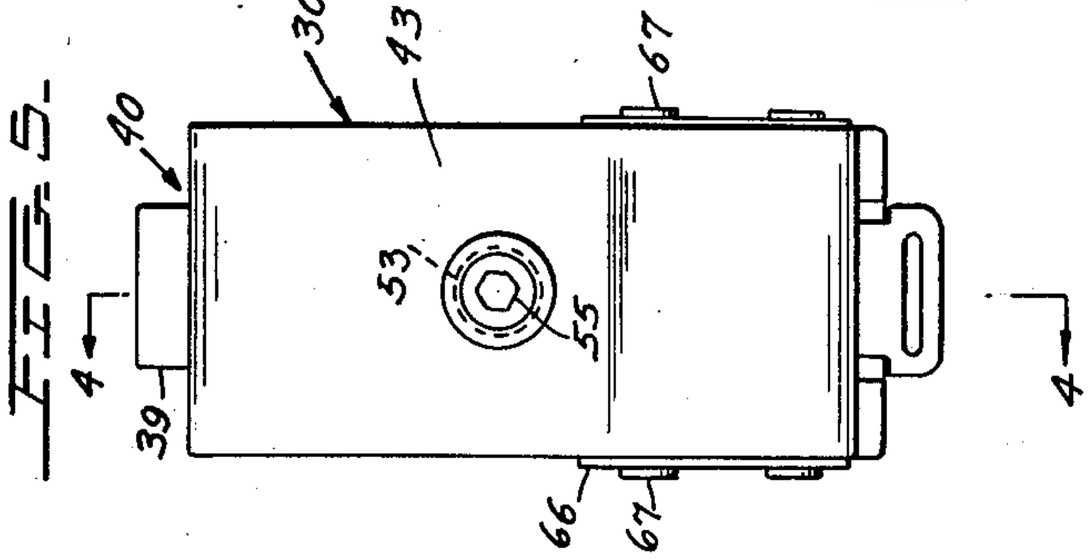
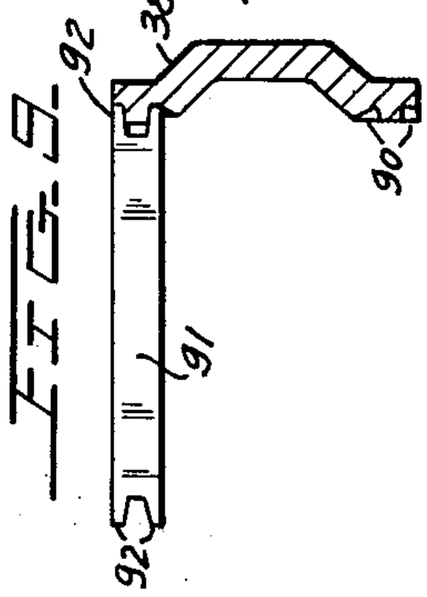


FIG. 9.



United States Patent Office

3,180,953

Patented Apr. 27, 1965

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3,180,953
AUTOMATIC TRIP DEVICE

Martin V. Zubaty, Philadelphia, Pa., assignor to I-T-E Circuit Breaker Company, Philadelphia, Pa., a corporation of Pennsylvania

Filed Feb. 19, 1962, Ser. No. 174,124
14 Claims. (Cl. 200—88)

The instant invention relates to circuit breakers in general and more particularly to a novel construction for an automatic trip device with special emphasis being placed upon the construction of the magnetic or instantaneous trip portion thereof.

In conventional molded case circuit breakers the instantaneous tripping means often comprises a magnet and an armature whose rotational bearings are placed in the circuit breaker base and secured by the cover. The armature is held against a stop in the base by an extension spring. Thus, the magnetic gap varies with tolerances of molded parts which are subject to extreme variations. As a result, desired tripping values are very difficult to obtain.

In other prior art constructions the magnet is mounted to the thermal means bimetal and the armature is placed free between the base and cover and held in the end position by an extension spring. With the latter arrangement, calibration varies with the adjustment of the thermal means and as a result it is very difficult to obtain the desired instantaneous trip setting.

The instant invention overcomes the disadvantages of the prior art by providing a construction in which the pole piece of the magnet and the armature are both mounted to a retainer clip. The clip is constructed of non-magnetic sheet material which is very readily and inexpensively manufactured to extremely close tolerances. The energizing turn for the magnet is provided by the bimetal heater which is mounted remote from the armature and is mounted such that adjustment thereof will not affect the spacing between the armature and pole faces.

Accordingly, a primary object of the instant invention is to provide a circuit breaker having a novel instantaneous trip device which is inexpensive to construct and is easy to calibrate.

Another object is to provide an automatic trip device of this type in which a spring retainer element is utilized to assemble the magnet and armature without any additional fastening means being required.

Still another object is to provide an automatic trip device which is extremely compact.

A further object is to provide an instantaneous trip device in which one or more flat spring elements, interposed between the armature and magnet, are utilized for calibration purposes.

These as well as other objects of this invention shall become readily apparent after reading the following description of the accompanying drawings in which:

FIGURE 1 is a plan view of a circuit breaker including the device of the instant invention.

FIGURE 2 is a cross-section taken through line 2—2 of FIGURE 1 looking in the direction of arrows 2—2.

FIGURE 3 is an exploded perspective of an automatic trip unit constructed in accordance with the teachings of the instant invention.

FIGURE 4 is a cross-section of the automatic trip unit taken through line 4—4 of FIGURE 5 looking in the direction of arrows 4—4.

FIGURES 5 and 6 are end views of the trip unit looking in the direction of arrows 5—5 and 6—6, respectively of FIGURE 4.

FIGURE 7 is a cross-section taken through line 7—7 of FIGURE 4 looking in the direction of arrows 7—7.

FIGURE 8 is a cross-section taken through line 8—8 of FIGURE 7 looking in the direction of arrows 8—8.

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FIGURE 9 is a plan view illustrating the manner in which the instantaneous trip means biasing spring engages the armature.

Now referring to the figures. Circuit breaker **15** is provided with a molded housing comprising base **16** and removable cover **17**. Base **16** is divided into three longitudinal compartments by partitions **18, 19**. The center compartment houses contact operating mechanism **20** of a type well known to the art which is effective to simultaneously operate cooperating contacts **21, 22** of both circuit breaker poles into and out of engagement.

Circuit breaker **15** is a two pole device with the current carrying elements of the respective poles being housed in the outer compartments of base **16**. The current carrying elements as well as the automatic trip device of each pole are the same. The current path for each pole comprises terminal strap **23**, stationary contact **22**, movable contact **21**, movable contact arm element **24**, flexible braid **25**, strap **26**, bimetal heater element **30** to terminal strap **31**.

Movable contact arm element **24** is pivotally mounted at **32** to contact arm element **33** with contact pressure spring **34** being interposed between elements **24** and **33** to provide contact pressure. Elements **33** of both poles are fixedly secured to cross bar **35** which is operated by mechanism **20** to bring about simultaneous opening and closing of contacts **21, 22** of both poles. Circuit breaker **15** also includes common tripper bar **36** biased to latching position (arrow A, FIGURE 2) in a manner well known to the art.

In order to bring about automatic tripping of circuit breaker **15**, each of the poles is provided with an automatic trip unit **40** including bimetal **39** and armature **38** which is attracted to the pole piece **37** of an electro-magnet. So-called instantaneous tripping takes place when armature **38** is attracted by pole piece **37** and moves in the direction of arrow B (FIGURE 2) and in so doing engages tripper bar extension **41**, thereby rotating tripper bar **36** in the direction opposite to the direction of arrow A. So-called time delayed tripping takes place when the upper or free end of bimetal **39** moves in the direction of arrow C (FIGURE 2) thereby engaging tripper bar extension **42** to operate tripper bar **36** in a direction opposite to the direction indicated by arrow A.

Bimetal heater element **30** is of generally rectangular shape having elongated opposite sides **43, 44**. The upper ends of sides **43, 44** are bridged by side **45** while side **46** extends from the lower end of side **43** but stops short of side **44**. Side **46** is provided with clearance aperture **47** which receives mounting screw **48**. The lower end of side **44** is provided with leg **49** extending away from side **43**. Leg **49** is provided with clearance aperture **50** which receives mounting screw **51**.

As clearly seen in FIGURES 3 and 6, side **44** is considerably narrower than sides **43, 45** and **46** so that most of the heating takes place at side **44**. The lower end of bimetal **39** is secured to the downward extension **52**, of side **44**, which is formed from extension **40**. The threads of adjusting screw **53** are mated with the threads of aperture **54** through side **43**. End **55** of screw **53** is provided with a suitably formed recess to receive an adjusting tool such as an Allen wrench while the other end of screw **53** is provided with a portion **56** of reduced cross section having an enlargement **57** at the free end thereof. Shoulder **58**, adjacent to portion **56**, abuts the inner surface of side **44** with portion **56** extending through clearance aperture **59** of side **44** and spring retainer **60** being interposed between enlargement **57** and the outside surface of side **44**.

As adjusting screw **53** is rotated clockwise, a force is directed to increase the spacing between the central por-

tions of walls 43 and 44. This re-positions the extension 52 of wall 44 thereby bringing the free end of bimetal 39 closer to tripper bar extension 42 thereby decreasing the delay tripping time of circuit breaker 15. Conversely, rotation of screw 53 in a counterclockwise direction will increase the spacing between the free end of bimetal 39 and tripper bar extension 42 thereby increasing the time delay tripping interval for circuit breaker 15. It is noted that end 55 of adjusting screw 53 is made accessible with the cover 17 of circuit breaker 15 in place merely by removing cover strip 62 which is disposed within slotted formations of base 16.

Pole piece 37 is a generally U-shaped member provided with pole faces 64, 65 which lie in a common plane. Pole piece 37 is nested within U-shaped retainer slip 66 with outward projections 67 of the pole piece U-arms disposed within apertures 68 in the U-arms of retainer clip 66. The web of pole piece 37 is provided with clearance aperture 69 while the web of the retainer clip 66 is provided with clearance aperture 70. Apertures 69 and 70 are aligned with aperture 47 of heater side 46 so that screw 48 extends through all three elements and constitutes a common fastening means.

The U-arms of retainer element 66 each include portions extending beyond pole faces 64, 65. These portions are provided with aligned apertures 71, 72 which receive outboard extensions 73, 74, respectively of armature 38 thereby defining a pivotal axis for armature 38. These portions of retainer clip 66 also include enlarged apertures 75, 76 which receive outboard extensions 77, 78, respectively, of armature 38. Apertures 75, 76 are considerably larger than extensions 77, 78 thereby permitting armature 38 to pivot toward and away from pole faces 64, 65.

Each of the U-arms of pole piece 37 is provided with an under cut portion 79 while armature 38 is provided with two sets of indentations 90. Somewhat V-shaped compression leaf spring 91 is interposed between pole piece 37 and armature 38 thereby urging armature 38 away from pole faces 64, 65. Each end of spring 91 is notched to provide a pair of closely spaced tips 92. Tips 92 at one end of spring 91 are received by one of the sets of notches 90 while the tips 92 at the other end of spring 91 are disposed on opposite sides of under cut 79 thereby securely positioning spring 91. The amount of force urging armature 38 away from pole faces 64, 65 is regulated by utilizing either a single spring 91 or two separate springs 91 located at opposite sides of armature 38. Further, this force is regulated by the characteristics and dimensions of the spring material. It is noted that retainer clip 66 is counstructed of non-magnetic resilient sheet material so that no additional fastening means are required to secure pole piece 37, armature 38 and retainer clip 66 together as a unit. Further, the mounting of pressure spring 91 is extremely simple and does not require the permanent deformation of any element.

Although preferred embodiments of this novel invention are described herein, many variations and modifications will now be apparent to those skilled in the art and, therefore, it is preferred that this invention be limited not by the specific disclosure herein but only by the appending claims.

The embodiments of the invention in which an exclusive privilege or property is claimed are defined as follows:

1. An automatic trip device for a circuit breaker, said device comprising an electro-magnet having a U-shaped pole piece including space-separated arms, a connecting web and pole faces lying in a common plane perpendicular to said U-forming arms and web, a U-shaped retainer element, said retainer element including space separated arms, said pole piece nested within said retainer element with the webs of the nested members adjacent to each other, said retainer element arms each including a portion extending beyond said U-shaped pole piece, and perpendicular to said pole faces; the extending portion of one of said arms having a first aperture located adjacent a first end of one of said pole faces, the extending portion of the other of said arms having a second aperture located adjacent a first end of the other of said pole faces; said first and second apertures in alignment and defining a pivotal axis across said pole faces at their first end; an armature for said electro-magnet; said armature including pivot means extending into said first and second apertures, for pivotally mounting said armature to said extending portions, such that the pivoted end of said armature extends across said pole faces at the first end thereof; spring means for urging said armature about said pivotal axis in a direction away from said pole faces.

2. The automatic trip device of claim 1 in which the retainer element comprises a member constructed of non-magnetic spring material.

3. The automatic trip device of claim 1 in which the spring means comprises an elongated leaf member one end of which bears against an arm of said U-shaped pole piece and the other end of which bears against said armature.

4. The automatic trip device of claim 1 in which the armature is provided with limit projections, said portions of said retainer element each having apertures within which said projections are disposed whereby movement of said armature away from said pole faces is limited to a predetermined position.

5. The automatic trip device of claim 1 in which the U-arms of the retainer element are provided with holes, the U-arms of the pole piece having projections disposed within said holes whereby said pole piece and said retainer element are operatively positioned as an integrally maintained unit.

6. The automatic trip device of claim 1 in which there are aligned clearance apertures in the webs of said retainer element and said pole piece, an elongated bimetal extending between the U-arms of the pole piece, and a member to which one end of the bimetal is mounted with the other end of the bimetal being free to deflect upon heating of the bimetal, said member including an aperture aligned with said aligned apertures whereby a common fastening member is useable for securing said bimetal and said pole piece within a circuit breaker housing.

7. A multi-phase circuit breaker including a pair of cooperating contacts for each phase; a mechanism for simultaneously operating said contacts of all phases between an engaged and a disengaged position; a common tripper bar which when operated to a trip position enables said mechanism to automatically operate said pair of contacts of all phases to said disengaged position; a magnetic trip device for each phase of said circuit breaker; each of said devices comprising an electro-magnet having a U-shaped pole piece including space-separated arms, a connecting web and pole faces lying in a common plane perpendicular to said U-forming arms and web, a U-shaped retainer element, said retainer element including space separated arms, said pole piece nested within said retainer element with the webs of the nested members adjacent to each other, said retainer element arms each including a portion extending beyond said U-shaped pole piece, and perpendicular to said pole faces; the extending portion of one of said arms having a first aperture located adjacent a first end of one of said pole faces, the extending portion of the other of said arms having a second aperture located adjacent a first end of the other of said pole faces; said first and second apertures in alignment and defining a pivotal axis across said pole faces at their first end; an armature for said electromagnet; said armature including pivot means extending into said first and second apertures, for pivotally mounting said armature to said extending portions, such that the pivoted end of said armature extends across said pole faces at the first end thereof; spring means for urging said armature about said pivotal axis in a direction away from said pole

faces; said armature being attracted by said electro-magnet and thereby moved about said axis toward said pole faces upon the occurrence of a predetermined overload condition, said armature in moving toward said pole faces operating said tripper bar to said trip position.

8. The circuit breaker of claim 7 in which there is a thermal trip device for each phase; each of said thermal trip devices comprising a bimetal which upon the occurrence of another predetermined overload condition will deflect sufficiently to operate said tripper bar to said trip position, said thermal trip device also comprising a heater member for said bimetal, said heater member mounted between the arms of said pole piece and being operatively positioned so as to constitute an energizing turn therefor, said heater member being mounted in heat transferring relationship to said bimetal.

9. The circuit breaker of claim 8 is which the bimetal of each phase is fixedly secured to said heater member, a common fastening means securing said heater member and said pole piece to a base of said circuit breaker.

10. The circuit breaker of claim 7 in which each of the retainer elements comprises a member constructed of non-magnetic spring material.

11. The circuit breaker of claim 7 in which each of the spring means comprises an elongated leaf member one end of which bears against an arm of said U-shaped pole piece and the other end of which bears against said armature.

12. The circuit breaker of claim 7 in which each of the armatures is provided with limit projections, said

portions of said retainer element each having apertures within which said projections are disposed whereby movement of said armature away from said pole faces is limited to a predetermined position.

13. The circuit breaker of claim 7 in which each of magnetic trip devices is constructed with the U-arms of the retainer element having holes, the U-arms of the pole piece having projections disposed within said holes whereby said pole piece and said retainer element are operatively positioned as an integrally maintained unit.

14. The circuit breaker of claim 7 in which each of the magnetic trip devices is constructed with aligned clearance apertures in the webs of said retainer element and said pole piece, an elongated bimetal extending between the U-arms of the pole piece, a member to which one end of the bimetal is mounted with the other end of the bimetal being free to deflect upon heating of the bimetal, said member including an aperture aligned with said aligned apertures, a common fastening means extending through said last recited aperture and said aligned apertures for securing said bimetal and said pole piece to a housing for said circuit breaker.

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ROBERT K. SCHAEFER, *Acting Primary Examiner.*