Sept. 23, 1958 J. H. FRAKES 2,853,538

ELECTRICAL BUSHINGS

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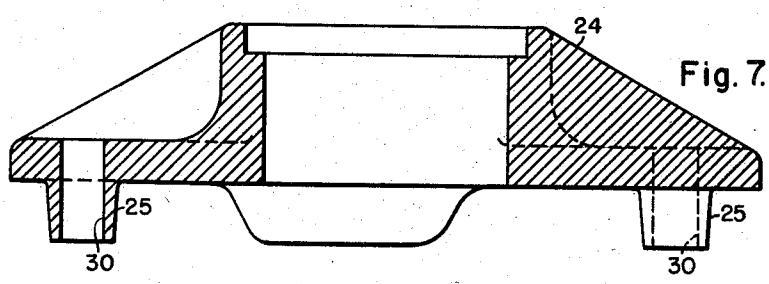


Fig. 7.

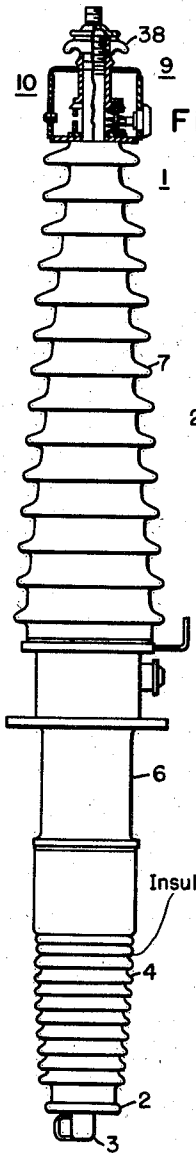


Fig. 1.

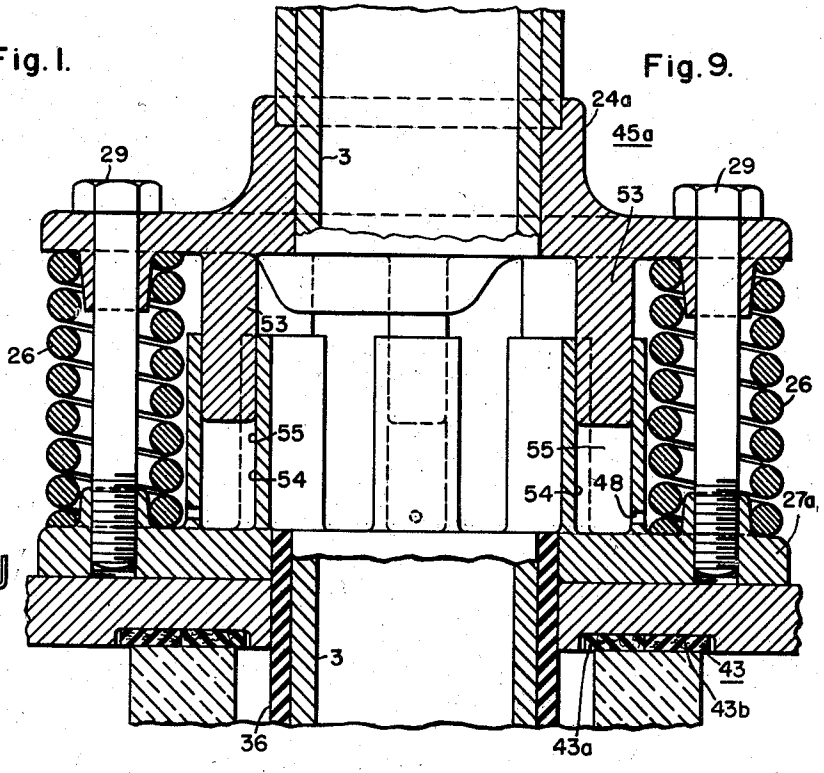


Fig. 9.

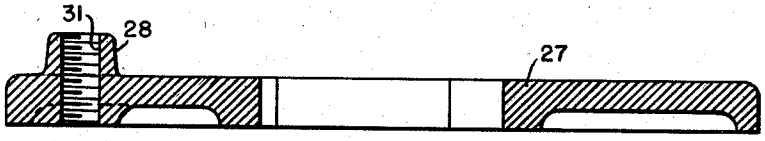


Fig. 8.

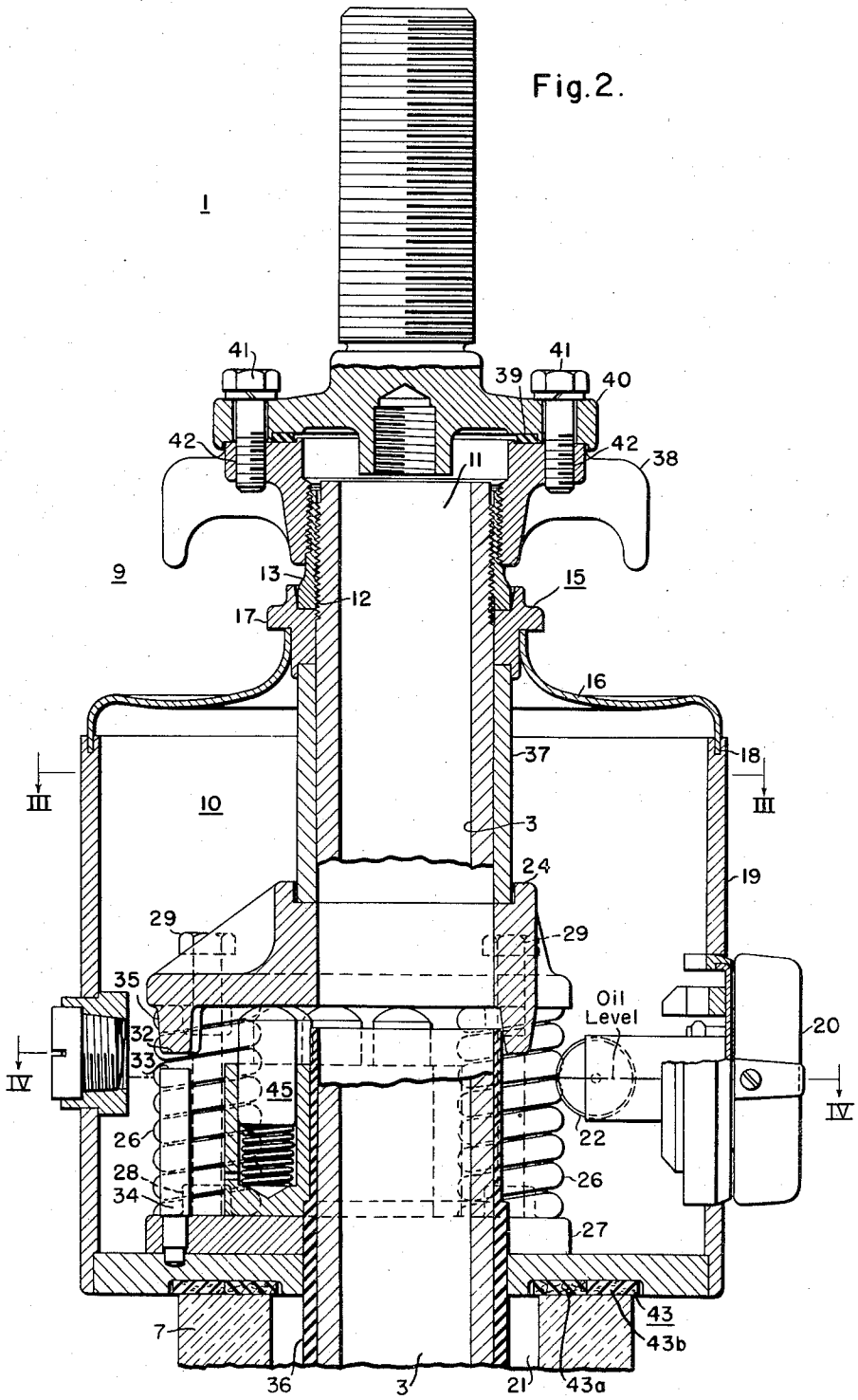
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Fig. 2.



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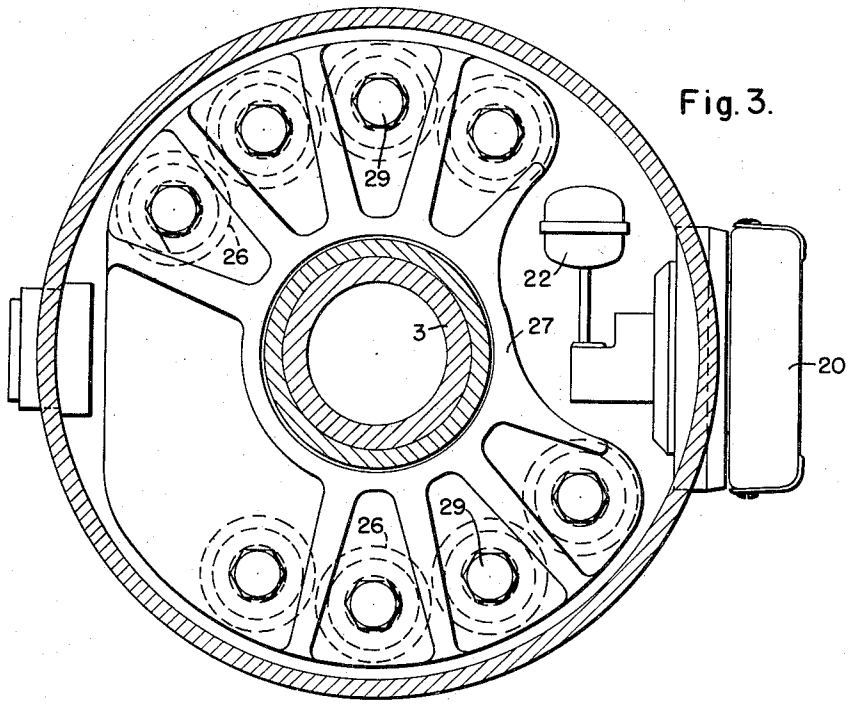


Fig. 3.

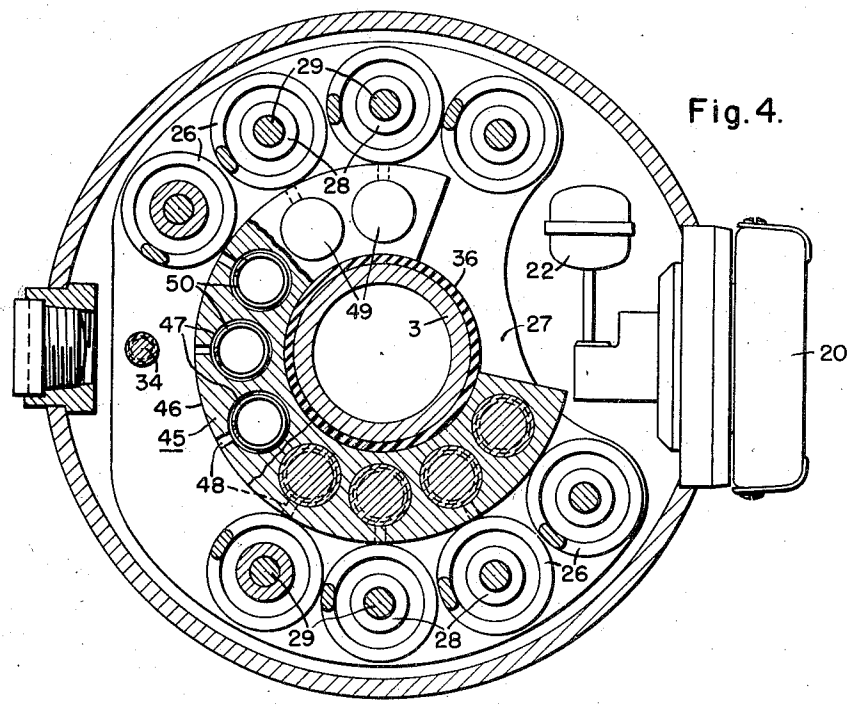


Fig. 4.

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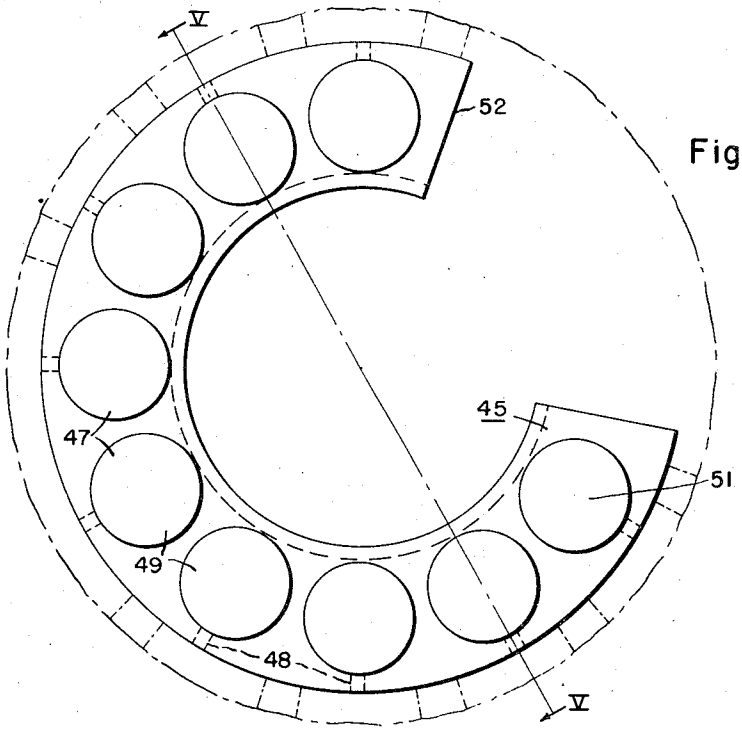


Fig. 6.

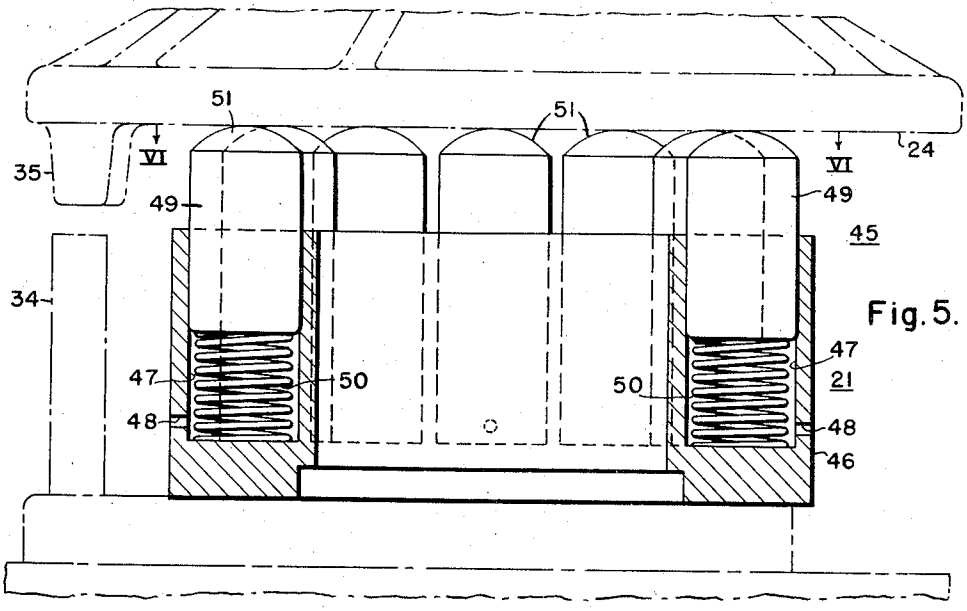


Fig. 5.

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ELECTRICAL BUSHINGS

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Application September 28, 1953, Serial No. 382,721

8 Claims. (Cl. 174—12)

This invention relates to terminal bushings in general, and more particularly to terminal bushings of the high-voltage type in which one or more weatherproof casings of an insulating material, such as porcelain, are maintained in compression, whereas an interiorly disposed stud or conducting tube is maintained in tension.

The general object of my invention is to provide an improved terminal bushing which will be adaptable for all conditions of service, which may include its use in circuit breakers where high-fault currents are interrupted.

A more specific object of my invention is to provide an improved dashpot assembly associated with a terminal bushing of the type employing spring pressure to maintain the weatherproof casing of the terminal bushing under compression, to prevent thereby excessive mechanical and electrical shock to the bushing.

It has been observed during the interruption of high-fault currents in circuit breakers of the liquid-break type involving a pair of high-voltage terminal bushings, that vibration and mechanical shock occurring during such high-fault current interruption tends to compress the gaskets and the porcelain casings during a portion of such operation and, on the other hand, to permit excessive relaxing of the gaskets so that on certain occasions oil may leak out of the high-terminal bushing at the gaskets during such high-fault current interruption.

It is a further object of my invention to associate an improved and highly effective dashpot arrangement with the spring assembly, generally disposed in the cap of a high-voltage terminal bushing, to prevent sudden movement, or to damp large scale differential movement between the interiorly disposed conductor stud and the surrounding weatherproof casing elements.

Still a further object is to provide a dashpot assembly associated with a terminal bushing of the type utilizing a compression spring assembly in which sudden differential movement between the interiorly disposed terminal stud and the surrounding weatherproof casing elements is dampened to prevent mechanical or electrical shock to the bushing.

Further objects and advantages will readily become apparent upon reading the following specification, taken in conjunction with the drawings, in which:

Figure 1 shows a side elevational view, partially in vertical section, of a high-voltage terminal bushing, in this instance one of the condenser-wound type, with a portion of the cap assembly broken away to indicate the spring assembly;

Fig. 2 is an enlarged fragmentary vertical sectional view taken through the upper cap assembly of the terminal bushing illustrated in Fig. 1;

Fig. 3 is a plan sectional view taken through the cap assembly of Fig. 2, substantially along the line III—III thereof;

Fig. 4 is a broken plan sectional view, taken substantially along the line IV—IV of Fig. 2;

Fig. 5 is an enlarged vertical sectional view through the improved dashpot assembly utilized in my invention,

indicating its relative position with respect to the spring cap and spring base plate castings;

Fig. 6 is a plan view taken along the line VI—VI of Fig. 5;

Fig. 7 is a vertical sectional view taken through the top spring cap of the spring assembly;

Fig. 8 is a vertical sectional view taken through the lower spring base of the spring assembly; and,

Fig. 9 illustrates a modification of my invention in which a double-acting dashpot dampens both excessive sudden elongation of the spring assembly and also excessive sudden compression of the spring assembly.

Referring to the drawings, and more particularly to Fig. 1 thereof, the reference numeral 1 generally designates a terminal bushing of the type employed in the cover of a circuit breaker of the liquid-break type, or a circuit breaker of any type disposed interiorly within a suitable tank structure. Also, such a terminal bushing 1 may be employed in connection with a transformer, by which the leads to the transformer may be brought exteriorly of an enclosing housing through two such terminal bushings 1.

It will be observed that the high-voltage terminal bushing 1 includes a lower porcelain support 2, which is screwed onto a lower threaded portion of a copper condenser tube, or terminal stud 3, the latter extending axially interiorly throughout the length of the terminal bushing 1. The lower porcelain support 2 abuts against a lower weatherproof casing, in this instance formed of porcelain, designated by the reference numeral 4, with a gasket, not shown, interposed therebetween. At the upper end of the lower porcelain 4 is an intermediately disposed flange assembly 6, which may be employed to mount the terminal bushing 1 upon a suitable tank, or housing, for electrical equipment, with which one or more of the terminal bushings 1 may be utilized.

Disposed upwardly from the flange assembly 6, which is generally at ground potential, is an upper weatherproof casing 7, in this instance formed of porcelain. Disposed at the top of the terminal bushing 1 is a cap assembly, generally designated by the reference numeral 9, and including a spring assembly 10 comprising, in this instance, several compression springs acting to maintain the porcelains 4 and 7 under compression, with the longitudinally extending copper condenser tube 3 under tension.

In this particular instance, the terminal stud 3 is of tubular configuration and carries the electrical current through the terminal bushing 1 itself, or, in certain instances, a terminal lead from the electrical apparatus may be fished through the hollow condenser tube 3, and be attached at the upper end thereof. As is customary in the art, because of the high voltage of the condenser tube 3, preferably capacitance shielding is employed to properly grade the voltage between the terminal stud 3 and the grounded flange assembly 6. This may include wrapping the condenser tube 3 with oil-impregnated paper and having at certain intervals metallic foil to provide the series plates of such a condenser. The upper and lower porcelains 4 and 7 protect the interiorly disposed terminal stud 3, with its condenser wrapping, from the weather, and, as mentioned, the flange assembly 6 at ground potential is employed to suitably mount the terminal bushing 1 upon a proper housing. Oil fills the casings 4 and 7 about the condenser wrapping for high dielectric strength.

Referring to Fig. 2, which more clearly illustrates the internal construction of the upper end of the terminal bushing 1, and more specifically the spring assembly 10 therefor, it will be observed that the condenser tube 3 is shown partly in section and has the upper end 11 threaded, as at 12, to receive an interiorly threaded sleeve 13, the latter being a portion of a spun cap assembly 15.

The spun cap assembly **15** includes a copper diaphragm **16**, which may flex to accommodate longitudinal differential movement between the condenser tube **3**, which is under tension, and the surrounding porcelain casings **4**, **7** which are under compression. The upper end of the copper diaphragm **16** is brazed to a thimble **17**, the latter in turn being brazed to the sleeve **13**. The lower end of the copper diaphragm **16** is brazed into a slot **18** formed at the upper end of a cap shell **19**.

A dial **20** indicates to an observer the level of oil, which fills the interior chamber **21** within the casings **4**, **7** and the cylindrical flange assembly **6**. Associated with the dial **20** is a gauge mechanism float **22** which floats upon the surface of the oil, and causes a proper indication of the oil level on the dial **20**.

The spring assembly **10** includes a top spring cap **24**, the configuration of which is more clearly shown in Fig. 7 of the drawings. It will be observed that at the lower end of the top spring cap **24** are a plurality of apertured bosses **25**, which serve as upper seats for a plurality of compression springs **26**.

The lower ends of the compression springs **26** seat upon a spring base **27**, the configuration of which is more fully apparent from an inspection of Fig. 8 of the drawings. The spring base **27** has a plurality of apertured and tapped bosses **28**, which accommodate a plurality of bolts **29**, the disposition of which is more fully apparent from Fig. 2 of the drawings. Thus, the bolts **29** slide through the apertures **30** in the bosses **25** of the spring cap **24**, pass interiorly through and guide the compression springs **26** and are threadedly received interiorly within the tapped apertures **31** provided in the spring base **27**.

As will be obvious to those skilled in the art, the bolts **29** are employed to precompress the compression springs **26** prior to assembly upon the condenser tube **3**. In other words, the bolts are threaded into the tapped apertures **31** until a proper separation distance exists between the gauge points **32**, **33**, more clearly shown in Fig. 2. The lower gauge point **33** consists of a pin **34** driven by a press fit within the spring base **27**, whereas the upper gauge point **32** may comprise merely a downwardly extending boss **35** integrally cast with the top spring cap **24**. The separation distance between the gauge points **32**, **33** indicates the amount of precompression of the several springs **26**, which, together with the spring plates **24**, **27**, and an interiorly disposed insulating sleeve **36**, collectively constitute a sub-assembly which may be slid upon the condenser tube **3** during the assembly of the terminal bushing **1**. Following the threading of the condenser tube **3** interiorly through the spring assembly **10**, a spacing sleeve **37** is mounted about the condenser stud **3**, after which the spun cap assembly **15** encircles the terminal stud **3** and is threadedly secured thereto.

Following such an operation, the lifting lug nut **38** is threadedly secured over the sleeve **13** and brazed thereto to provide an oil-tight joint. Then follows a gasket **39** and an adaptor cap **40**, which is secured in place by a plurality of machine bolts **41** screwed into tapped apertures **42** provided in the lifting lug nut **38**.

With poreclain casing **4** clamped between lower porcelain support **2** and grounded flange assembly **6**, pressure is applied between flange assembly **6** and thimble **17** to compress springs **26** to the required pressure, as determined by the gap distance between gauge points **32** and **33**. Sleeve **13** is then screwed down against thimble **17** to hold springs **26** in compression. At this stage, the bolts **29** are loose to permit the spring pressure exerted by the several compression springs **26** to place the porcelain casings **4** and **7** under compression and the conductor stud **3** under tension.

The foregoing structure has been found to provide a desired differential movement between the terminal stud **3** and the porcelains **4** and **7** during operation of the terminal bushing **1**, with expansion of the oil within the chamber **21** accommodated, all being caused by temperature changes. Preferably nitrogen gas is disposed above the oil level to prevent oxidation of the oil.

When the terminal bushing **1** is used in circuit breaker installations, or in other installations, where excessive mechanical or electrical shocks are encountered, sudden compression of the springs **26** may permit leakage of oil to take place outwardly from the chamber **21** past the gaskets, one of which is shown near the lower end of Fig. 2, and is collectively designated by the reference numeral **43**. It comprises a pair of concentrically disposed gaskets, one of which **43***a* may be resilient and provide a fluid-type joint, whereas the outer one **43***b* provides a stop to limit excessive compression of the internal gasket **43***a*. Should the compression springs **26** be compressed suddenly, excessive oil may leak past the gasket **43**, which action of course is highly undesirable, as it will necessitate refilling the oil within the condenser bushing **1**.

To prevent such sudden excessive vibration and mechanical shock taking place, I associate a dashpot means, generally designated by the reference character **45**, with the spring assembly **10**, as more clearly shown in Fig. 5 of the drawings. The dashpot assembly **45** comprises a lower operating-cylinder plate **46** having a plurality of operating cylinders **47** provided therein, which vent through small leak apertures **48** to the region **21** within the casings **4** and **7**. Operating within the several cylinders **47** are a plurality of pistons **49** biased upwardly to a limiting position against the top spring cap **24** by a plurality of relatively light compression springs **50**. The compression springs **50** constantly maintain the tops **51** of the pistons **49** against the top spring plate **24**. For clarity of illustration, the compression springs **26** have been omitted from Fig. 5.

Fig. 6 illustrates a top plan view taken on the dashpot means **45**, showing the tops **51** of the pistons **49**, and illustrating how the casting **46** may have a quarter section removed therefrom, as at **52**, to permit its encirclement of the condenser stud **3**.

It will be obvious that should a sudden compression of the compression springs **26** attempt to take place, the oil disposed back of the pistons **49** will prevent sudden compression of the springs **26** taking place. This will prevent leaking at the several gaskets **43**.

Fig. 9 shows a modification of the invention wherein the dashpot means **45***a* includes a double-acting dashpot assembly, including plungers **53** integrally formed with the top spring cap **24***a*. A plurality of operating cylinders, or cavities **54**, are integrally formed with the lower spring plate **27***a*, and again bleeder openings **48** are provided to restrict oil flow out of the piston chambers **55**. It will be observed that the modified dashpot is double-acting so that it will prevent sudden compression of the springs **26**, and sudden elongation thereof, since suction will occur during elongation of the springs **26**, and compression of the oil within the piston chambers **55** will occur upon sudden compression of the springs **26**.

From the foregoing description of my invention, it will be apparent that I have provided an improved dashpot means associated with the spring assembly to maintain continuous pressure on the gasket joints of high-voltage bushings regardless of expansion or contraction of the parts with temperature changes. Experimental tests have shown that on high interrupting kva. breakers the bushings, which are subject to electrical and mechanical forces during heavy short-circuit current interruption will not permit sudden compression of the springs **26** taking place due to the action of the dashpot means **45**. Therefore, sudden movement tending to release pressure on the gasket seals to cause opening, or to put tremendous pressure on the gasket or bushing parts is avoided. I have utilized an oil dashpot located between the spring compression points and below the oil level in the bushing.

This dashpot restrains any sudden movement of the springs by forces as encountered during breaker heavy-current interruption, but has sufficient leakage of oil to permit slow spring movement with expansion and contraction due to temperature cycles.

The several pistons fit closely within their cylinders, and the light springs **50** hold the pistons **49** in proper position. The small bleeder openings **48** permit oil to flow slowly in and out of the operating cylinder when necessary. When the piston moves up and down slowly in the cylinder, oil runs in or out of the holes 48 in the cylinders to permit movement. When a sudden pressure on the bushings tries to move the piston down in the cylinder, the oil does not have time to escape through the small hole **48**, and the oil blocks the sudden movement of the piston **49**. This oil dashpot is for keeping the springs **26** from compressing suddenly, and the plungers **53** in the double-acting dashpot arrangement of Fig. 9 prevent the sudden compression or elongation of the springs **26** in Fig. 9.

Incorporating the dashpot assembly **45** within the terminal bushing **1** results in the terminal bushing **1** being utilized in connection with high-voltage fault current interruption without leakage of terminal bushing oil taking place through one or more of the gasket seals **43**. Moreover, excessive stress upon the porcelains **4** and **7** has been eliminated and the terminal bushing **1**, as a whole, is adapted for applications involving mechanical and electrical shock.

Although I have shown and described specific structures, it is to be clearly understood that the same were merely for the purpose of illustration, and that changes and modifications may readily be made therein by those skilled in the art, without departing from the spirit and scope of the invention.

I claim as my invention:

1. A terminal bushing including a longitudinally extending tension member, one or more casing elements, spring means for placing the casing elements under compression and the tension member under tension, and dashpot means including a piston for preventing sudden differential movement between the casing elements and the tension member.

2. The combination in a terminal bushing of one or more casing elements and an interiorly disposed conducting tension member, spring means for exerting tensile stress on the conducting tension member and compressive stress on the casing elements, and dashpot means including a piston for preventing sudden relative movement between the two.

3. A terminal bushing including a longitudinally extending tension member, one or more casing elements, spring means including a plurality of compression springs

for exerting tensile stress on the tension member and compressive stress on the casing elements, and a dashpot including a piston for preventing sudden compression of the compression springs.

4. The combination in a terminal bushing of one or more casing elements and an interiorly disposed conducting tension member, spring means including a plurality of compression springs for exerting tensile stress on the tension member and compressive stress on the casing elements, and a dashpot including a piston for limiting sudden differential movement between the tension member and the casing elements.

5. The combination in a terminal bushing of the type wherein biasing means exerts tensile stress on a longitudinally extending tensile member and compressive stress on one or more casing elements, characterized by a dashpot including a piston to prevent sudden movement of the biasing means.

6. A terminal bushing including a longitudinally extending tension member, one or more casing elements, spring means including a battery of circularly disposed compression springs for exerting tension on the tension member, a pair of spring plates, and a dashpot including a plurality of concentrically arranged piston elements for preventing sudden differential movement between the tension member and the one or more casing elements.

7. A terminal bushing including a longitudinally extending tension member, one or more casing elements, spring means for placing the casing elements under compression and the tension member under tension, and a double-acting dashpot including a piston for preventing sudden differential movement between the casing elements and the tension member.

8. The combination in a terminal bushing of one or more casing elements and an interiorly disposed conducting tension member, spring means for exerting tensile stress on the conducting tension member and compressive stress on the casing elements, and a double-acting liquid dashpot for preventing sudden relative movement between the two.

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