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THERMO-RESPONSIVE SWITCH

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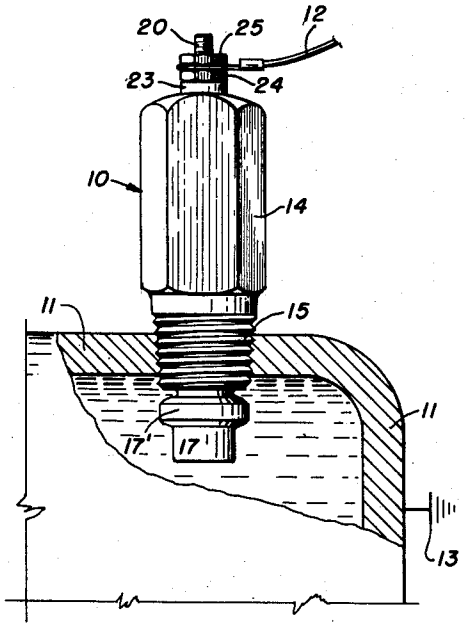


Fig. 1

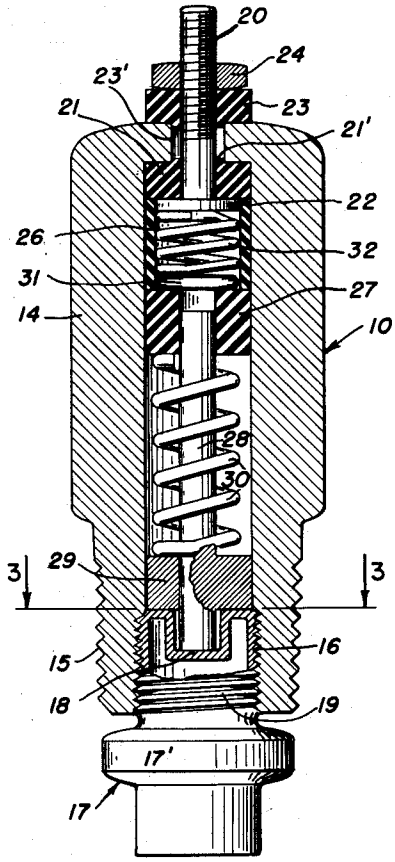


Fig. 2

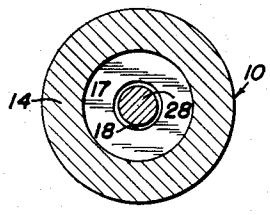


Fig. 3

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THERMO-RESPONSIVE SWITCH

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This invention relates to adjunctive facilities operable in association with electrically-governed apparatus subject to elevation of working temperatures to inhibit overheating of the apparatus through automatic application of selected working temperature upper limits to such regulation of the electrical governing system of the operating equipment as will avert, by arrest of operation, or otherwise, rise of working temperatures to an impractical, or damaging, degree, and has as an object to provide a novel and improved thermo-responsive switch unit adapted to close a normally-open electrical circuit in reaction to temperature elevations whereto exposed.

A further object of the invention is to provide a novel and improved thermo-responsive switch adapted to automatically close for completion of an electrical circuit in reaction to elevation of temperatures to which it is exposed and to automatically open to a reset condition of potential use upon abatement of the actuating temperature.

A further object of the invention is to provide a novel and improved thermo-responsive switch that is particularly adapted for intended use with isolated and unattended powered equipment installations exposed to weather and therewith rugged and dependable in attainment of its functions.

A further object of the invention is to provide a novel and improved construction and operative interrelation of elements in and as a thermo-responsive switch applicable to inhibit overheating of electrically-governed, powered apparatus.

A further object of the invention is to provide a novel and improved thermo-responsive switch that is economical of production, simple and convenient of operative installation, expediently adaptable for operative reaction to temperature limits selected from a wide temperature range, reliable in repetitious function free from servicing and maintenance requirements, substantially immune to adverse effect by climatic environment or the extremes of weather variations, and positive and efficient in attainment of the ends for which designed.

With the foregoing and other objects in view, my invention consists in the construction, arrangement, and operative combination of elements as hereinafter set forth, pointed out in the appended claims, and illustrated by the accompanying drawing, in which—

FIGURE 1 is an elevation view of a typical embodiment of the invention as applied in use association with the cylinder water jacket of a conventional internal combustion engine, or the equivalent, fragmentarily shown in partial section with indication of its customary inclusion in and to complete an electrical circuit.

FIGURE 2 is a longitudinal section, on a relatively-enlarged scale, through and substantially axially of the switch unit represented by FIGURE 1, a conventional unitary thermal element utilized as a component of the improvement being but generally shown in partial section adequate to establish its coaction with other features of the switch unit assembly.

FIGURE 3 is a transverse section taken substantially on the indicated line 3—3 of FIGURE 2.

It is common experience in the operation of internal combustion engines, powered pumps, compressors, and analogous mechanical apparatus, however cooled and lubricated, that overheating of the operating mechanisms

may occur and persist to a degree, if not observed and promptly countered, destructive of the equipment with concomitant interruption of the ofttimes critical functions thereof. Technical advances in many fields and services have aggravated the problems and consequences of equipment failure due to overheating because of the expanding practice of locating powered equipment installations remote from observation and prompt access to operate, either continuously or intermittently, without attention for long periods of time subject to malfunction promotive of or consequent upon overheating. Previous recognition of the unpredictable possibility of excessive temperature elevation incident to equipment operation has hitherto occasioned the provision of means effective in exposure and reaction to the variable operating temperatures of a given equipment installation to halt the action thereof in automatic response to abnormal rise of such temperatures before critical overheating occurs. Commonly applied to control the efficacy of an electrical circuit governing operation of the associated equipment, the temperature-responsive means hitherto available for the purpose discussed have been less than satisfactory by reason of structural complexity, indurability, especially when exposed to weather, over-sensitivity, expense, vulnerability as attractive targets for gunners, lack of automatic resetting capability, and inadequate practical reliability, in correction of all of which the instant invention is directed to the provision of a novel and improved thermo-responsive switch diversely applicable in appropriate exposure to fluids, either vapor or liquid, which reflect the operating temperatures of associated equipment to positively and dependably close an electrical circuit controlling operation of the equipment at a predetermined degree of temperature elevation.

Manifestly adapted to function as intended in practical association with equipment of many different types, constructions, and capabilities subject to possible overheating during operation, the improved switch of the invention is constituted as a rugged unitary assembly designated generally by the numeral **10** applied to the views of the drawing and is shown in FIGURE 1 as associated for use with and in engagement through an exterior wall **11** of an engine water jacket, or the equivalent, adapted to confine coolant circulated with reflection of engine operating temperature in a customary manner. Connectible as may be expedient for a given installation as a switch in and for control of an electrical circuit, the arrangement according to FIGURE 1 represents the unitary assembly **10** as a component of a circuit typified by the lead **12** susceptible of completion to ground at the engine structure, as indicated by the conventional ground symbol **13**, through said assembly.

Significant to the rugged dependability and durability of the unitary switch assembly **10** in any and all conditions of its practical use is the operative correlation of all of the switch elements and components in and with an axially-elongated, generally-cylindrical, heavy-walled, metallic case **14** formed with a major axial bore opening fully through one end thereof and extending as a cylinder of uniform diameter thence to near the opposite end of the case where it terminates in shouldered relation with a coaxial, lesser bore intersecting the otherwise closed end of the case. At and about its end fully intersected by the major bore, the case **14** is externally threaded, as indicated at **15**, for coaction with mating, internal threads of an orifice intersecting the wall **11** of the engine water jacket, or analogous component of the equipment to be served by the switch assembly, whereby to effect secure, detachable mounting of the unit in appropriate use relation with areas indicative of overheating, the exterior of the case **14** apart from the threads

15 is desirably worked to a transversely-angular conformation coactable with tools manipulable to mount and to remove the unit relative to use position, and at the end carrying the threads 15 said case is threaded internally for a relatively-short distance along and inwardly from the fully open end of its major bore, as indicated at 16.

The threads 16 within and adjacent the fully open end of the major bore of the case 14 provide means for the detachable and interchangeable association of a thermal element 17 in operative coaction with the case 14 and switch components housed therewithin. The thermal element 17 functions, as will hereinafter appear, to reflect temperature elevation to which it is subject as mechanical actuation of switch components correlated therewith and is, in and of itself, no distinctive feature of the instant invention which is devised to realize its purposes in association with, and in reaction to, thermal elements that are commercially available in conventional constructions appropriate for adaptation to such use. As typified in the views of the drawing and without regard to its temperature-responsive composition and internal organization, the thermal element 17 of commercial availability suitable for use as an actuating component of the invention is a sealed capsule of elongated, generally-cylindrical form having an annular radial enlargement 17' intermediate its ends, a coaxial, floored, cylindrical socket 18 intrusively interrupting one closed end, and external threads 19 adapted to mate with the threads 16 of the case 14 on and about its end portion characterized by said socket. Featured by the socket 18 and threads 19 as shown and described, the conventional thermal element 17 of known, and selected, thermal reactive value is engaged by means of its threads 19 within and to close the open end of the major bore of the case 14 with the socket 18 of said element disposed to open inwardly and axially of the bore, as shown in FIGURE 2, in which detachable and interchangeable connection to the case 14 the element 17 is mounted for introduction and exposure within the heat-reflecting medium, liquid or vapor, confined by a member of the operating equipment, such as the wall 11, whereto and wherethrough the case 14 is engaged by means of its threads 15, as is exemplified by the showing of FIGURE 1.

At the shouldered end of the major bore of the case 14 remote from the position of the thermal element 17, a headed, threaded stud 20 extends loosely through, and out of contact with the walls of, the lesser bore opening through the end of the case remote from the threads in traversing relation with an insulating, or dielectric, block 21 interposed within the major bore of the case between the head 22 of said stud and the shouldered end of said bore and through a complementary insulating, or dielectric, block 23 disposed thereabout to bear against the end of the case 14 in closing relation over the outer end of the lesser bore, in which disposition said stud is secured and detachably retained by a nut 24 coacting with the threaded stud portion projecting axially and outwardly of the case to interclamp, in opposition to the stud head 22, the blocks 21, 23, and the case end therebetween, in a manner to intrude annular fillets 21' and 23', respectively, from said blocks and within the proximate ends of the lesser bore closed thereby for retention of the stud 20 in spaced, non-contacting relation with walls of the bore wherethrough it extends. Organized as shown and described, the stud 20 serves as a binding post, electrically-isolated from the case 14, connectible exteriorly of the case with and to extend to its head 22 the circuit represented by the lead 12, as by means of a nut 25 running on the threaded exterior end of the stud in a usual manner effective to clamp a connector terminating said lead securely, and detachably, against the nut 24. In a diameter less than that of the major bore of the case wherein it is housed, the head 22 of the stud 20 is received within and embraced by one end of a tubular sleeve 26, of insulating or dielectric material, conformably and slidably housed within the major bore of the case in end-abutting closure against the adjacent face of the block 21, whereby said head is electrically isolated from the case, and a centrally-apertured block 27, of insulating or dielectric material, conformably and slidably engages within the major bore of the case to end-abut and in a substantial axial thickness close over the end of the sleeve 26 remote from the block 21, whereby to define an insulated chamber containing the head 22 of the stud 20 within said sleeve 26. Coaxial with the major bore of the case 14, a cylindrical, metal stem 28 formed with a fixed, radially-expanded, annular collar 29 spaced inwardly from one of its ends a distance corresponding with the depth of the socket 18 of the element 17 and sized for free reciprocation axially of said bore is housed within the case with its end adjacent said collar loosely received in and based on the floor of said socket, the collar 29 accordingly engaged against the annular inner end of the element 17 surrounding said socket, and the other end of the stem reciprocably retained in the central aperture of the block 27, in which arrangement of relatively-shiftable components an expansive coil spring 30 loosely about the stem 28 between and to bear at its ends against opposed areas of the block 27 and collar 29 acts to yieldably urge the stem 28 to its seat within the socket 18 as determined by engagement of the collar 29 against the inner end area of the element 17 and to consolidate the blocks 21, 27 and sleeve 26 in the end-abutting coaction above described. The stem 28 is of a length to partially, but not fully, traverse the axial dimension of the block 27 when said stem is retracted by the spring 30 away from said block and to its seat in and on the element 17, whereby to establish and normally maintain a slight spacing between the face plane of the block 27 opposed to the block 21 and the adjacent end of the stem exposed within the central aperture of said block 27, and a contact member 31 in the form of a metallic disk or button overlies the face plane of the block 27 opposed to the block 21 loosely and shiftably within the insulated chamber typified by the sleeve 26 where it is yieldably biased toward the adjacent end of the stem 28 by an expansive coil spring 32 reactive between the opposed areas of said member 31 and the head 22 of the stud 20.

Organized as shown and described, the improved switch assembly of the invention equipped with a conventional thermal element 17 as set forth functions when connected at the exterior end of its stud 20 to the lead 12 of an appropriate electrical circuit and through its case 14, in any suitable manner, to the completing continuation of such circuit with normal interruption of the circuit and capability to close and complete the circuit in automatic reaction to temperature increase received and reflected by the thermal element. Conventionally constructed to reflect rise of the temperature to which it is subject by a mechanical displacement of the floor of its socket 18 axially and oppositely away from the other end of the capsule, the element 17 in exposure as an extension from the end of the case 14 to media indicative of the variable operating temperatures of associated equipment operates in response to a predetermined degree of temperature elevation whereto it is inherently reactive with displacement of the floor of its socket 18 axially and inwardly of the case 14 to effect consequent shift of the stem 28 and collar 29 against the pressure of the spring 30 to engagement of the innermost end of said stem against the contact member 31 for completion of the associated circuit through the contacting metallic elements of the assembly. Manifestly, any overtravel of the stem 28 beyond initial end-contact with the member 31 is accommodated without impairment of the switch organization by the spring 32, and upon abatement of the temperature effective to actuate the element 17 the springs 30 and 32 automatically reset the movable com-

ponents of the assembly and open the circuit with the switch positioned and conditioned for reuse, the provision for engagement of the collar **29** against the annular inner end of the element **17** precluding the possibility of damage to the socket **18** of the element **17** derivable from the associated end of the stem **28**.

The electrical circuit including and controlled by the thermo-responsive switch of the invention may be applied in any feasible way to arrest operation of the associated equipment when the circuit is completed through closing of the switch, thereby to forestall damage to the equipment resulting from continued operation at excessive temperatures, it being obvious that ordinary skill of the art should suffice to variously adapt the so-controlled circuit to interrupt an ignition circuit to an engine, to actuate relays, and the like, effective through related means to obviate, in one way or another, damage resulting from continued operation of associated equipment at excessive temperatures, and to energize signals indicative of a condition requiring attention.

Since changes, variations, and modifications in the form, construction, and arrangement of the features and elements shown and described may be had without departing from the spirit of my invention, I wish to be understood as being limited solely by the scope of the appended claims, rather than by any details of the illustrative showing and foregoing description.

I claim as my invention:

1. A thermo-responsive switch comprising an elongated case adapted at one end for mounted engagement with and through a wall, a thermal element interchangeably fixed in and projecting outwardly from said one end of said case, said element being adapted to expand longitudinally and inwardly of the case in reaction to temperature increase of the medium whereto it is exposed, conductive means through and insulated from the other end of said case connectible in an electrical circuit thereby terminated interiorly of the case, a contact member yieldably and conductively biased away from the inward end of said means, apertured insulating means opposing the bias of said member in exposure of the member therethrough, and adjunctive conductive means yieldably biased away from said insulating means within said case to coaction with said thermal element and normally away from contact with said member shiftable by expansion of said element in guided relation with and fully through the aperture of said insulating means into contact with said member for consequent completion of the associated circuit.

2. A thermo-responsive switch comprising an elongated case adapted at one end for mounted engagement with and through a wall, a thermal element interchangeably fixed in and projecting outwardly from said one end of said case, said element being adapted to expand longitudinally and inwardly of the case in reaction to temperature increase of the medium whereto it is exposed, conductive means through and insulated from the other end of said case connectible in an electrical circuit thereby terminated interiorly of the case, a centrally-apertured block of dielectric material transverse of said case and inwardly thereof from said means, a contact member insulated from and shiftable longitudinally of the case yieldably and conductively biased away from the inward end of said means to engage and close over the aperture of said block, and a stem of conductive material end-entered in the aperture of said block and yieldably biased therefrom within the case to coaction with said thermal element and normally away from contact with said member, said stem being shiftable by expansion of said element fully through said block and into contact with the member for consequent completion of the associated circuit.

3. A thermo-responsive switch comprising an elongated case adapted at one end for mounted engagement with and through a wall, a thermal element interchangeably fixed in and projecting outwardly from said one end of said case, said element being adapted to expand longitudinally and inwardly of the case in reaction to temperature increase of the medium whereto it is exposed, conductive means through and insulated from the other end of said case connectible in an electrical circuit thereby terminated interiorly of the case, an insulated chamber housing the inward end of said means defined in part by an apertured stop spacedly opposed to the inward end of said means transversely of the case, a contact member shiftable longitudinally of the case within said chamber yieldably and conductively biased away from the inward end of said means to engagement against said stop, and a stem of conductive material yieldably biased longitudinally of the case in guided relation at one end through said stop to coaction with said thermal element and normally away from contact with said member shiftable by expansion of said element into contact with the member for consequent completion of the associated circuit.

4. A thermo-responsive switch comprising an elongated case adapted at one end for mounted engagement with and through a wall, a thermal element interchangeably fixed in and projecting outwardly from said one end of said case, said element being adapted to expand longitudinally and inwardly of the case in reaction to temperature increase of the medium whereto it is exposed, a headed binding post connectible in an electrical circuit engaged through and insulated from the other end of said case with its head terminating the circuit interiorly of the case, an insulated chamber enclosed by a tubular sleeve and associated transverse apertured stop of dielectric material housing the head of the binding post inwardly of the case, a contact member shiftably accommodated in said chamber, a spring in said chamber between said member and the head of the binding post yieldably and conductively biasing the member to engagement against said stop away from the head, a stem of conductive material longitudinally of the case between coaction with the thermal element at one end and guided engagement through said stop at its other end in a length slightly less than the span separating said contact member from the thermal element at temperatures inadequate to expand the latter, a radially-expanded collar fixed to said stem, and a spring between said collar and the opposed face of said stop yieldably biasing said stem to coaction with the thermal element and away from contact with said member for shift by expansion of said element into contact with the member and consequent completion of the associated circuit.

5. The organization according to claim 4, wherein said thermal element is formed at one end with a central socket disposed to open inwardly of the case and having a floor shiftable inwardly of the case in reaction to increase of temperature affecting the element, said stem is sized at its end coactable with the element to seat loosely in and against the floor of said socket, and the collar carried by the stem is related therewith to engage the annular end portion of said element about the socket when the stem is fully entered therewithin.

6. A thermo-responsive switch comprising an elongated, heavy-walled, metallic case formed with a coaxial major bore opening fully through one of its ends in a length slightly less than that of the case, a lesser bore coaxially continuing said major bore through the other end of the case, and means for mounting the case in engagement of the end intersected by the major bore with and through a wall, a thermal element having a central, intrusive socket in one end provided with a floor shiftable axially and outwardly of the element in reaction to temperature increase affecting the latter interchangeably fixed in and to close the open end of the major bore of the case with its socket directed to open longitudinally and inwardly of the case and the principal portion of the element projecting outwardly from the case, a headed binding post connectible in an electrical circuit fixed through said lesser

bore and insulated from the case with its head exposed interiorly and at the inward end of the major bore of the case, a sleeve of dielectric material housing the head of the binding post and terminating outwardly of the bore in spaced relation therewith, a centrally-apertured, axially-thick block of dielectric material transversely closing the end of the sleeve remote from the binding post head to define with said sleeve an insulated chamber at the inward end of the major bore of the case, a contact member shiftably accommodated in said chamber, a spring in said chamber between said member and the head of the binding post yieldably and conductively biasing the member away from the head and to engagement against said block in covering relation with the central aperture thereof, a stem of conductive material longitudinally of the case between loose, seated reception at one end in the socket of the thermal element and guided engagement at its other end within the central aperture of said block in a length slightly less than the span separating said contact member from the floor of the socket at temperatures inadequate to shift the latter, a radially-expanded collar fixed to said stem inwardly from the stem end received

in the socket a distance equal to the socket depth, and a spring between said collar and the opposed face of said block yieldably biasing said stem to full end-reception within the socket and concomitant coaction of said collar with the annular end portion of the thermal element about the socket for shift of said stem into contact with said member and consequent completion of the associated circuit in reaction to temperature-promoted movement of the floor of the thermal element socket, and for return of said stem to potential use condition upon abatement of the temperatures reactively affecting the thermal element.

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