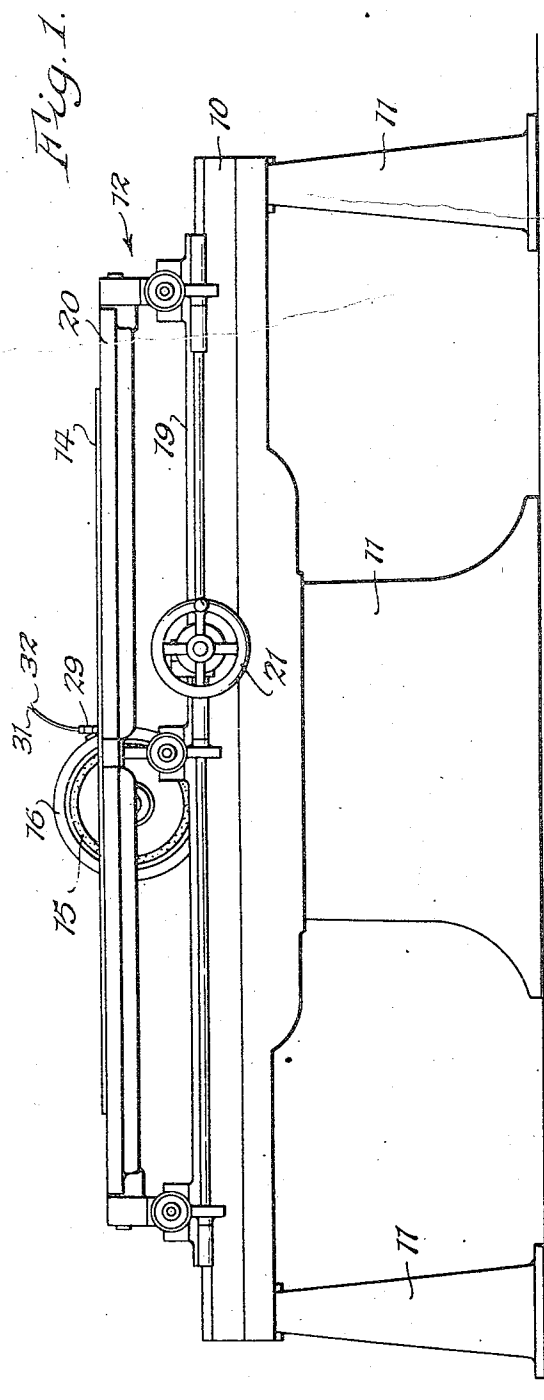
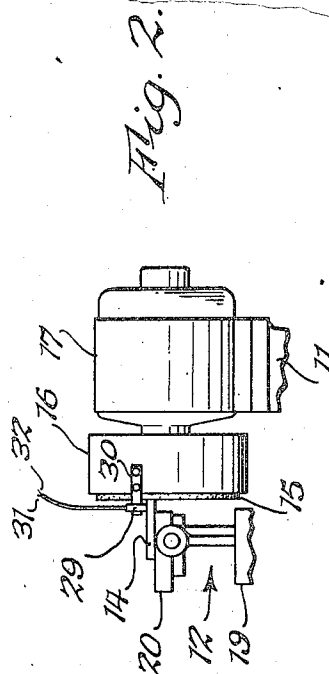


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TEMPERATURE RESPONSIVE DEVICE FOR USE
ON GRINDERS AND METHOD OF GRINDING
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2,427,064

2 Sheets-Sheet 1



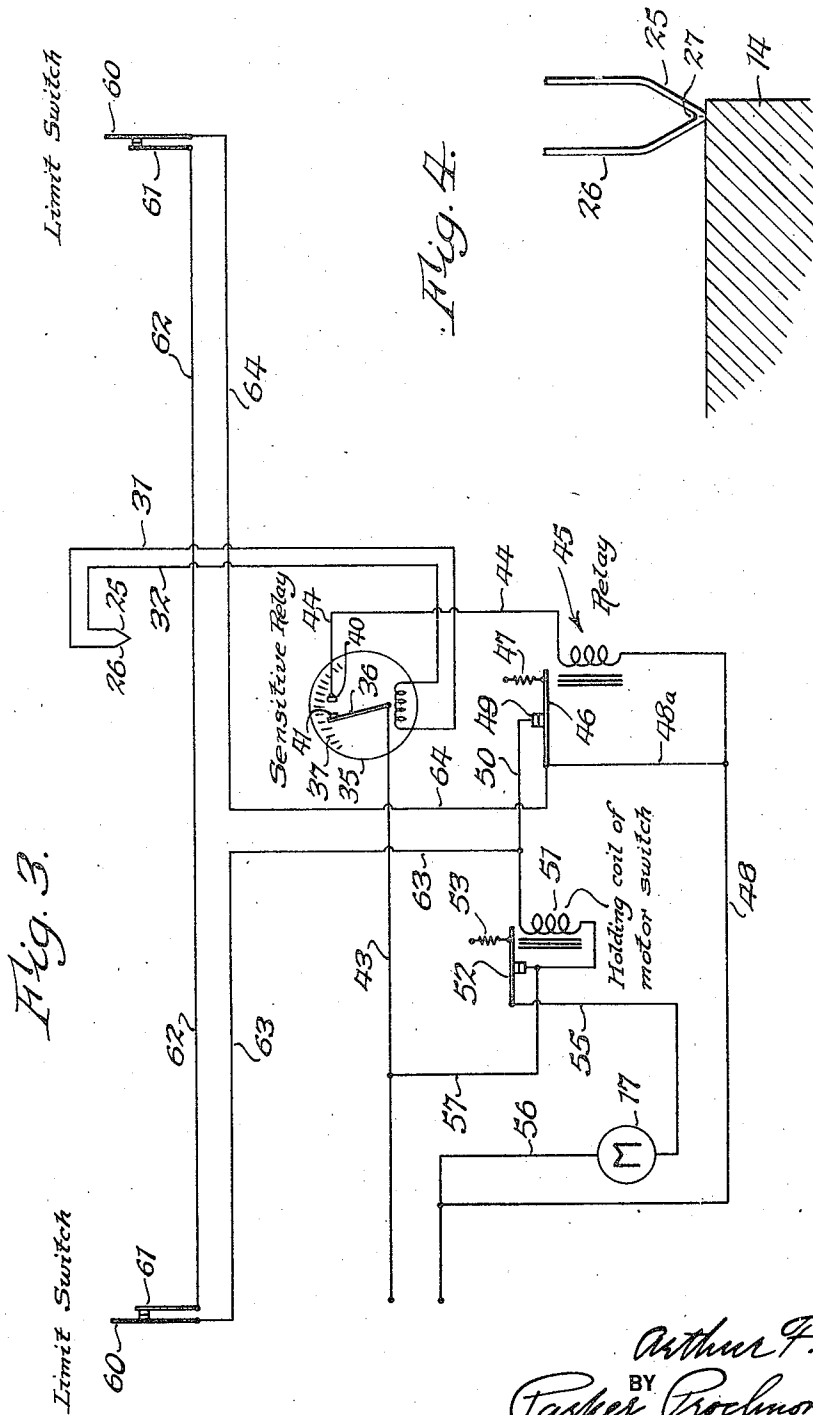
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TEMPERATURE RESPONSIVE DEVICE FOR
USE ON GRINDERS AND METHOD OF
GRINDING

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13 Claims. (Cl. 51—2)

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This invention relates to improvements in grinding surfaces of materials in such a manner as to avoid heating the materials to such an extent as to damage the same.

It is well known that when surfaces of certain materials are ground in such a manner that the temperature of portions of the material is materially increased, such material may become damaged due to local heating and in the case of steels and other metals, the tempers of the same may be destroyed. The temperatures at which steels of various kinds lose their tempers vary considerably. Furthermore, steels are not always of uniform texture and sometimes the steel may contain hard spots which become excessively heated during grinding while other parts of the steel became heated to a materially less extent, thus causing internal strains in the molecular structure of the steel, which may result in damage to or fracture of the steel.

One of the objects of this invention is to provide a method of and means for employing temperature responsive means in connection with grinding surfaces or edges of work, whereby damage to the work which is being ground due to excessive temperatures can be avoided. A further object of this invention is to provide a heat responsive device which is arranged to contact the material which is being ground in the immediate vicinity of the portion thereof which is being subjected to the grinding action, and by means of which accurate information as to temperature can be obtained. A further object is to provide a heat responsive device, which is connected with an indicator for indicating the temperature of the portion of the work which is being ground. Another object is to provide a temperature responsive device of this kind which is arranged to modify the operation of a grinding machine when the work which is being ground attains a temperature in excess of that desired. Another object is to provide a mechanism including a temperature responsive device contacting the work in the immediate vicinity of the portion thereof which is being ground and which is connected with the grinding machine in such a manner as to interrupt the operation of the machine when the work becomes heated to a point beyond which it is not safe to continue. Other objects and advantages of this invention will appear from the following description and claims.

In the accompanying drawing, in which is shown by way of example one embodiment of this invention:

Fig. 1 is a front view of a grinding machine having a heat responsive device embodying this invention applied thereto.

Fig. 2 is a fragmentary end view thereof, showing the abrasive wheel in operative relation to the work and showing a heat responsive device embodying this invention applied thereto.

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Fig. 3 is a diagram showing electrical connections employed for modifying the operation of a grinding machine when the work becomes heated beyond the desired extent.

Fig. 4 is a fragmentary enlarged sectional view showing a thermocouple applied to a workpiece.

The machine shown in Figs. 1 and 2 is of the type commonly employed for grinding large knives, such for example as paper cutter knives, metal shear blades and the like, but it will be understood that this invention may be applied to any other type of grinding machine. This machine has a horizontal bed 10 suitably supported by legs or pedestals 11 from a floor. On the bed of the machine is mounted a suitable support 12 for the work, which in the construction illustrated is mounted to move back and forth lengthwise of the bed 10 of the machine. 14 represents the work, which may be a paper cutting knife or sheet metal shear, or cutter, or any other article to be ground. 15 represents the grinding or abrasive wheel which is mounted to rotate in the fixed guard or housing 16. The grinding wheel may be rotated in any suitable or desired manner, and in the construction shown, an electric motor 17 is directly connected with the shaft of the grinding wheel. The motor may be mounted on any suitable support (not shown) mounted in fixed relation to the bed of the machine, for example, on the middle pedestal 11.

The work support 12 includes a lower part 19 which is slidably mounted on the bed 10 of the machine, and on which a work supporting table 20 is mounted. The table is adjustable to various angular relations with reference to the plane of the grinding surface of the grinding wheel 15; which, as shown, is of the cup type of which the radial edge only is used for grinding. The work supporting table 20 may be adjusted by any suitable mechanism, not shown in detail, and including a hand wheel 21 by means of which the table may be moved from the horizontal position shown in Figs. 1 and 2 to any desired angular position. Consequently, if a beveled edge is to be ground on the work, the angular adjustment of the table 20 determines the angle of the bevel. The table 20 is also movable toward and from the grinding wheel in a direction transverse of the longitudinal movement of the work support 12, and means may be provided as is customary in machines of this type, for advancing the table automatically toward the grinding wheel. Since, however, this invention is not concerned with any particular type of grinding machine, these detailed parts of the machine are not shown or described. It is also possible to construct the machine with a stationary work support and with a grinding wheel which reciprocates lengthwise of the work and the improvements herein described may be applied to such type of grinding machine or to any other type.

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In accordance with this invention, a temperature responsive member of any desired type is applied in contact with the work in such a manner that any change in temperature of that part of the work which is subjected to grinding, will immediately affect the heat responsive unit. Any type of heat responsive unit may be employed, which responds quickly to any changes in temperature, and in the particular construction shown, there is shown by way of example a thermocouple, which includes two wires or rods 25 and 26 of different metals or alloys and welded or otherwise secured together at their ends, as shown at 27. These connected ends of the two wires or rods are caused to bear against the work. The bearing of the heat responsive device against the work may be accomplished in any suitable or desired manner. For example, a series of these thermocouples may be placed at spaced intervals lengthwise of the work and may remain in fixed relation to the work, or one or more heat responsive devices may be arranged to slide lengthwise of the work in contact therewith in such a manner that the thermocouple or other heat responsive device will bear against the work as near as possible to the portion thereof which is engaged by the grinding wheel. For example in Figs. 1 and 2, the heat responsive device is mounted in a suitable holder or casing 29 made of insulating material, and which is mounted in turn on an adjustable bracket 30 suitably secured to the guard 16 of the grinding wheel. In the case of dry grinding, it is merely necessary that this holder support the thermocouple or other heat responsive device. If water or other cooling medium is supplied to the work, this guard or holder may be made of rubber or other material to keep the moisture out of contact with the heat responsive device. Also the holder 29 may have the end thereof contacting the work about the heat responsive device and wipe away any abrasive particles or liquid on the work so as to save the thermocouple from excessive abrasion or from contact with the cooling liquid. The two wires or rods of the thermocouple are connected by suitable electrical conductors 31 and 32 for carrying the thermo-electric current generated by the thermocouple. In the construction shown in Figs. 1 and 2, an edge of the work 14 is ground, which is approximately at a right angle to the opposite faces of the work, and thermocouple is shown in contact with one of the flat faces of the work in immediate proximity to the edge which is being ground. If a beveled edge is ground on the work, it is preferable to have the temperature responsive element contact the edge portion on the face opposite to that which is being ground and as near as possible to the thin portion of the beveled edge, since this part of the edge becomes heated most rapidly to nearly the same temperature as the surface which is subjected to the abrasive action. It is, however, also possible to have the thermocouple contact and move along the surface which is being ground, and this may be accomplished by mounting a thermocouple at either side of the grinding wheel, or in the case of cupped grinding wheel, within the cupped portion so as to be as near as possible to the part of the work which is being ground. However, it is not intended to limit this invention to the particular position to which the heat responsive element is mounted, since any position of the same where it is readily responsive to changes in temperature of the portion of the work which is being ground may be selected. For ex-

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ample, in Fig. 2, the temperature responsive device may engage the lower surface of the work 14, or the edge which is being ground, adjacent to the abrasive wheel.

If a thermocouple is used, the thermocouple will generate a thermo-electric current which is approximately proportional to the temperature to which the end of the thermocouple is exposed. This current is supplied to an instrument of any suitable or well known type which will indicate the amount of the electric current generated by the thermocouple. In the particular construction illustrated, the two conductors 31 and 32 leading from the thermocouple pass to a measuring instrument 35 of this type, Fig. 3, which has a needle or pointer 36 which is movable in proportion to the amount of electricity developed in the thermocouple. The needle 36 may be used merely to indicate the amount of thermo-electric current generated in connection with suitable graduations 37, Fig. 3, upon a dial or card which may be calibrated to read directly the temperature of the part of the work contacted by the thermocouple.

As thus far described, this invention is very useful in connection with the grinding of materials. It is generally well known to what temperature a material, such for example as a steel or an alloy, may be raised, without becoming damaged, but heretofore no means have been devised for determining when a temperature is reached beyond which it is not safe to continue the grinding. These excessive local temperatures may in the case of certain materials cause unequal expansion of different parts of the work, and thus cause failure due to cracking or checking of the work. In the case of steels or other metals which are tempered, an excessive heating of the work may result in loss or impairing of the temper of the metal. It also frequently happens that steels or other metals have spots or areas therein of varying size which may be of slightly different composition or physical structure and which during grinding become more heated than adjacent parts of the metal. Without any indication as to the temperatures of the work which is being ground, a considerable percentage of the work which is ground is damaged. Furthermore, because of the possibility of damaging work by excessive temperatures, there is a decided tendency on the part of the operators of grinding machines to grind the work very slowly to avoid such temperatures, and this results in unnecessary inefficiency and loss of time in grinding. By means of this invention, as thus far described, the temperature of the article can be accurately determined by merely observing the needle or hand 36 with reference to its scale 37. If at any time during grinding, the needle 36 indicates high temperatures approaching the danger point, steps may be taken to reduce this temperature, either by supplying more cooling liquid if a liquid is being used, by slowing the rotation of a grinding wheel, or by decreasing the rate of feed of the work to the stone, or by stopping the machine long enough to let the work cool off. By means of the temperature indicator, it is also possible to increase the efficiency of the grinding operation, in the event that the indicator shows the temperatures to be so low that an increase in the rate of grinding could be safely adopted.

The improved method of grinding here described, therefore, not only saves work from damage by excessive temperatures, but also makes it possible to increase the efficiency of grinding by

conducting a grinding operation at higher temperatures which, nevertheless, are not high enough to damage the work, thus reducing the time required for the grinding operation.

It is also readily possible to use the device described for the purpose of modifying grinding operations in case dangerously high temperatures are indicated. For this purpose, the pointer or needle 36 of the meter 35 may be connected to a suitable source of power and provided with an adjustable contact for closing the circuit when the high temperature is reached. In the construction shown for this purpose, a contact 40 is provided with which the needle 36 may contact when it reaches a temperature beyond which grinding cannot be continued safely, and this contact 40 is preferably adjustable along the scale 37 so that the operation of grinding may be modified at various temperatures. This adjustability is desirable if the grinder may at times operate on different steels or other materials which may be ground at different temperatures.

In order to make the contact positive and reliable, the contact member 40 may be in the form of a magnet and a small piece of magnetic material 41 may be secured on the needle 36. The needle is connected with a conductor 43 which in turn connects with a source of current supply, and the contact 40 is connected with a conductor 44 which is connected to one terminal of a relay 45 controlling a switch 46 which is normally held in circuit closing position by means of a spring 47, but which is moved into open position when current is supplied to the relay 45. The other terminal of the relay 45 is connected by a conductor 48 to the other side of the supply line, a branch 48a of conductor 48 being connected to the movable switch member 46.

The switch 46 is urged by the spring 47 into contact with a terminal 49 connected to a conductor 50 which passes to a holding coil 51 of a control switch 52 in the circuit of the motor 17. The motor control switch 52 is normally held in open circuit position by means of a spring 53, but may be moved into and held in closed position by means of the holding coil 51 when the switch 46 is closed. The movable member of the switch 52 is connected to one terminal of the motor 17 by conductor 55, the other terminal of the motor being connected by a conductor 56 to the line or source of power. The stationary contact with which the motor control switch 52 engages when in circuit closing position is connected by means of a conductor 57 to the other side of the line.

It will be obvious from the foregoing that when the needle 36 of the thermo-electric current meter or sensitive relay 35 is in engagement with the contact 40, through the relay 45, the relay switch 46 will be opened, thus interrupting the supply of current to the holding coil 51 of the motor switch 52, and thus permitting the motor switch to be moved into open position to stop the operation of the motor. It is, however, very advisable not to stop the operation of the motor, at any time except when the grinding wheel is out of engagement with the work, since otherwise a scoring of the work results. For this purpose, it is preferable to apply limit switches to the circuit shown in Fig. 3, which limit switches are in parallel arrangement with the relay operated switch 46, so that the motor will not be stopped unless both the relay switch 46 and one or the other of the limit switches is in open circuit position. These limit switches, which are arranged at the opposite ends of the travel of the

grinding wheel or the work, depending upon the type of grinding machine which is used, each include a movable switch member 60 and a stationary contact member 61, the movable switch member being located in the path of movement of the grinding wheel or the work. The two stationary switch members 61 are connected by a conductor 62 and the movable switch members 60 are connected to conductors 63 and 64, the conductor 63 being connected to the conductor 60 and the conductor 56 being connected with the branch conductor 48a which is connected to the relay operated switch member 46. The two limit switches are, consequently, connected in series with each other and in parallel with the relay switch 46. Consequently, if the relay actuated switch 46 is moved into open position because of high temperature of the work, the grinding operation will not be stopped until either limit switch 60 is moved into open position, which will occur when the grinding wheel is out of engagement with the work.

The connections disclosed in Fig. 3 are merely illustrative of one type of actuating means for using the heat responsive device for interrupting the grinding operation. It will be obvious, however, that other ways of utilizing the heat responsive device may be employed.

By means of the apparatus described, a machine may be set up for a grinding operation and started, and will require no further attention unless the machine is stopped, so that one operator can attend a considerable number of machines without danger of damaging the work. If the needle 36 indicates a relatively low temperature, the grinding operation may be speeded up. Since the temperature responsive device or the thermocouple cannot be placed in contact with the actual surface which is being ground, but only in proximity to such surface, or on a surface immediately after the grinding wheel has moved away from it, suitable allowance must be made for the readings indicated by the needle 36 of the meter, since these readings will be somewhat lower than the actual temperatures at the part on which the grinding wheel is acting.

While this invention is shown in the drawings as applied to a machine for grinding edges of work, yet it will be obvious that this invention is equally applicable to any other type of machine for grinding metals and non-metallic materials, and for grinding any surfaces thereof.

I claim as my invention:

1. A method of grinding work by means of a grinding wheel, which includes applying a heat responsive device to the work adjacent to the portion thereof which is being ground, and modifying the grinding of the work when said heat responsive device encounters temperatures approaching closely to the maximum temperature at which the work can be ground without damaging the same.

2. A method of grinding work by means of an abrasive wheel on a machine in which said wheel and the work move relatively to each other, comprising holding a heat responsive device in moving contact with the work at portions thereof immediately adjacent to the portion which is acted upon by the wheel, and modifying the grinding action when said heat responsive device encounters a temperature of a part of the work which approaches the temperature at which the work may be damaged by heat.

3. A method of grinding work by means of a grinding wheel, which includes applying a heat

responsive device to the work adjacent to the portion thereof which is being ground, and stopping the grinding of the work when the temperature indicated by said heat responsive device encounters a temperature above which the work may be damaged.

4. A method of grinding work by means of an abrasive wheel, which includes applying a temperature responsive indicating device to the work adjacent to the portion thereof which is being ground, and regulating the grinding of the work in accordance with the temperatures indicated by said device, by increasing the rate of grinding when the temperatures indicated are materially below the maximum safe grinding temperatures, and decreasing the rate of grinding when the temperatures indicated approach closely to the maximum safe grinding temperatures.

5. A method of grinding work by means of an abrasive wheel on a machine in which said wheel and the work move relatively to each other, comprising holding a heat responsive device in moving contact with the work at portions thereof immediately adjacent to the portion which is acted upon by the wheel, and stopping said machine when said heat responsive device encounters a temperature above which further grinding may damage the work.

6. A device for use in connection with the grinding of work by an abrasive wheel, which includes a temperature responsive member arranged to contact the work in such close proximity to the portion thereof which is being ground as to be subjected to changes in temperature of said portion of the work, means connected with said member and having a part which is moved by variations in the temperature of the portion of the work contacted by said member, and means actuated by said part for stopping said abrasive wheel when said temperature responsive member encounters a temperature above which further grinding may damage the work.

7. A device for use in connection with the grinding of work on a machine by an abrasive wheel, which includes a temperature responsive member arranged to contact the work in such close proximity to the portion thereof which is being ground as to be subjected to changes in temperature of said portion of the work, and means connected with said member for modifying the operation of said machine when said member encounters a temperature above which further grinding may damage the work.

8. A device for use in connection with the grinding of work on a machine by an abrasive wheel, which includes a temperature responsive member arranged to contact the work in such close proximity to the portion thereof which is being ground as to be subjected to changes in temperature of said portion of the work, and means connected with said member for stopping the operation of said machine when the portion of the work contacted by said member reaches a temperature above which further grinding may damage the work.

9. A device for use in connection with the grinding of work by an abrasive wheel on a machine providing relative reciprocatory motion between said wheel and the work and in which said wheel moves out of contact with the work at the end of each reciprocation, said device including a temperature responsive member arranged to engage the work in such close proximity to the portion thereof which is being ground as to be sub-

jected to changes in temperature of said portion of the work, a part which is moved by variations in the temperature of the work contacted by said member, and means for interrupting the operation of said machine when said part encounters a temperature above which further grinding may damage the work and when said abrasive wheel is out of engagement with the work.

10. A device for use in connection with the grinding of work by an abrasive wheel on a machine providing relative reciprocatory motion between said wheel and the work and in which said wheel moves out of engagement with the work at the end of each reciprocation, said device including a thermocouple contacting the work adjacent to the portion thereof which is being ground, a switch for controlling the operation of said machine and controlled by said thermocouple for opening said switch when said thermocouple encounters a temperature above which further grinding of the work may damage the same, and a limit switch on said machine connected in parallel with said first mentioned switch for stopping the operation of said machine when said abrasive wheel passes out of engagement with the work, for stopping said machine when both of said switches are open.

11. A device for use in preventing overheating of work during grinding of the same by an abrasive wheel, which includes a thermocouple, means for maintaining said thermocouple in sliding contact with the work in such close proximity to the portion of the work which is acted on by said abrasive wheel that said thermocouple will be subjected to changes in temperature of said portion of the work, and electric means connected with said thermocouple for indicating the temperature of the portion of the work contacted by said thermocouple.

12. A device for controlling the grinding of work by an abrasive wheel to prevent overheating of the work, including a thermocouple, means for maintaining said thermocouple in sliding contact with work which is being ground in such close proximity to the portion of the work acted upon by said abrasive wheel that said thermocouple will be subjected to changes in temperature of said portion of the work, and electrical connections actuated by said thermocouple for interrupting the grinding operation when said thermocouple encounters a temperature above which further grinding may damage the work.

13. A device in accordance with claim 12 and including a casing enclosing said thermocouple and slidable in contact with the work for keeping abrasive particles and cooling liquid out of contact with the thermocouple.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,102,518	Johnson	Dec. 14, 1937
2,267,391	Astrowski	Dec. 23, 1941
2,255,094	Aeppli	Sept. 9, 1941
1,370,381	Tarbox	Mar. 1, 1925

FOREIGN PATENTS

Number	Country	Date
542,573	Germany	Jan. 26, 1932