May 11, 1943. H. T. CLARK 2,318,923

TESTING APPARATUS

Filed Sept. 8, 1939

Fig. 1.

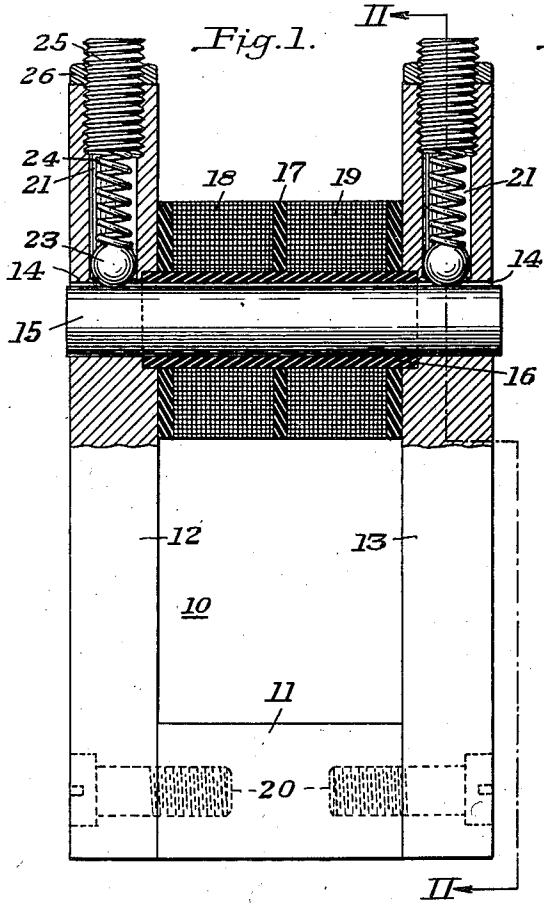


Fig. 2.

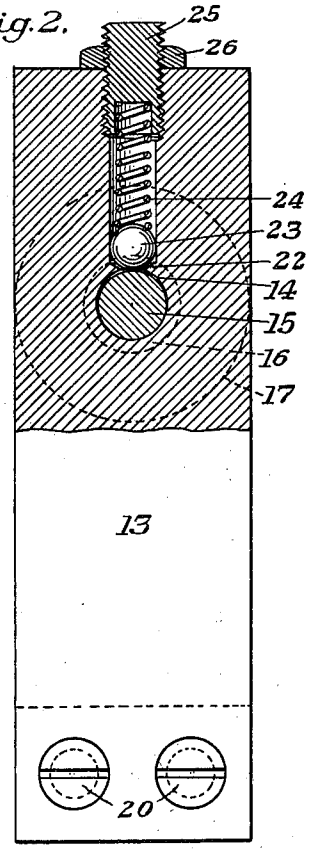
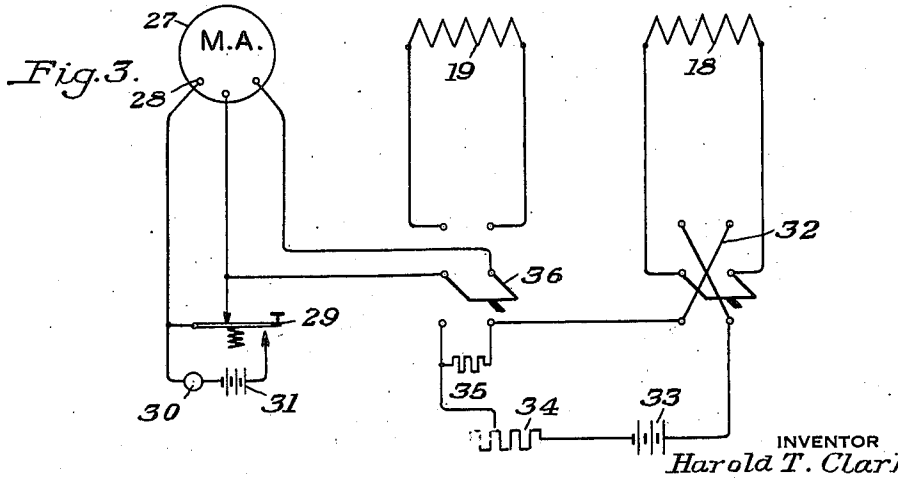


Fig. 3.



INVENTOR
Harold T. Clark
by his attorneys
Stebbins, Blenko & Parmelee

Patented May 11, 1943

2,318,923

UNITED STATES PATENT OFFICE

2,318,923

TESTING APPARATUS

Harold T. Clark, Pittsburgh, Pa., assignor to Jones & Laughlin Steel Corporation, Pittsburgh, Pa., a corporation of Pennsylvania

Application September 8, 1939, Serial No. 293,964

2 Claims. (Cl. 175—183)

This invention relates to testing apparatus and, in particular, to magnetic testing apparatus of the type including a magnetic yoke, the legs of which are adapted to be bridged by a specimen to be tested in the form of a bar.

Magnetic testing apparatus of the yoke and bar type has been used for various purposes but all the types of such apparatus with which I am familiar are characterized by a serious objection, viz., the variable reluctance of the magnetic circuit resulting from variations in contact pressure between the bar specimen and the yoke. Various expedients have been resorted to in attempts to overcome the inaccuracy involved in the variable reluctance. In the first place, efforts have been made to reduce the reluctance resulting from the minute air gap between the bar specimen and the yoke by carefully machining and even grinding the contacting surfaces of the specimen bar and yoke. This procedure is objectionable because of the time and expense involved in the machining and grinding operations, particularly where numerous specimens must be tested in quick succession.

Another expedient is the introduction of a small air gap in the magnetic circuit which has a reluctance much greater than that of the relatively minute air gaps between the specimen and yoke so that variations in the latter effect only a very small percentage of error. Testing apparatus of this type requires a large magnetizing force, i. e., a large number of ampere turns. The magnetizing coil of testers such as those here being considered are usually supplied with current from a battery, in order to avoid inaccuracies resulting from changes of applied voltage. It is evident that the higher the magnetizing force required, the more bulky and expensive the battery must be in order to provide the necessary current capacity or voltage, depending on the character of the conductor from which the magnetizing coil is wound. A further objection to this type of apparatus is that if it is wound for a relatively large magnetizing current, the heating effect of the latter will cause changes in the temperature and therefore the resistance of the exciting coil which introduces further inaccuracies.

I have invented a tester of the bar and yoke type which avoids all the aforementioned objections. In a preferred embodiment of the invention, I provide a magnetic yoke adapted to receive a bar specimen in bridging relation to the legs of the yoke. I also provide means for urging the bar against the yoke with a substantially constant, predetermined pressure, when the bar is once placed in cooperative relation with the yoke. The yoke itself is made without any air gaps, thereby reducing the required magnetizing force so that the yoke can be sufficiently excited by a relatively small and inexpensive battery, without excessive drain thereon. The yoke has openings adapted to receive the bar specimen, sufficient clearance being provided to permit easy introduction and withdrawal of the latter.

A complete understanding of the invention may be obtained from the following detailed description of the preferred embodiment, referring to the accompanying drawing illustrating the latter. In the drawing,

Fig. 1 is a side elevation with a portion shown in section along a central, vertical plane;

Fig. 2 is a view partly in elevation and partly in section taken along the line II—II of Fig. 1; and

Fig. 3 is a circuit diagram.

Referring now in detail to the drawing, the testing apparatus of my invention comprises a magnetic yoke 10 composed of a base 11 and legs 12 and 13. The legs have holes 14 therein which are in alinement and thereby adapted to receive a bar specimen 15 in bridging relation to the legs. As shown in the drawing, there is a slight clearance between the bar and the holes 14 whereby the bar may be easily inserted and removed.

The holes 14 are counterbored on the inner sides of the legs 12 and 13 to receive the ends of a bushing 16 forming part of a spool 17. A magnetizing coil 18 and an induction coil 19 are wound on the spool 17. The legs 12 and 13 are secured to the base 11 by screws 20. The device may conveniently be assembled by positioning the spool 17 with the projecting ends of the bushing 16 thereof in the counterbored portions of the holes 14 and then inserting the screws 20 through counterbored holes in the legs 12 and 13 and threading them into tapped holes in the base 11.

The legs 12 and 13 have longitudinal bores 21 extending inwardly from the outer ends thereof. These bores intersect the holes 14 but the intersections are of reduced diameter providing shoulders 22. Bearing members 23 may be in the form of balls or other suitable shape and are so disposed in the bores 21 as normally to protrude slightly into the holes 14. Springs 24 in the bores 21 are compressed between the balls 23 and recessed plugs 25 threaded into the outer ends of the bores 21 which are suitably counterbored and tapped. The plugs 25 preferably have their outer end slotted to accommodate a screwdriver and are provided with lock nuts 26.

As already stated, the balls 23 normally protrude slightly into the holes 14. When the bar 15 is inserted through the holes 14, the balls 23 are slightly displaced but, by reason of the springs 24, exert a substantially constant, predetermined force against the bar, urging its ends

against the opposite sides of the holes 14. When the testing operation is completed, the bar specimen 15 may easily be removed since the balls 23 effect little or no restraint against axial movement of the bar.

The device of my invention may be used in the same manner as magnetic yoke and bar testers previously known; that is to say, the magnetizing coil 18 may be connected through a reversing switch to a suitable battery, and the induction coil 19 connected to a ballistic galvanometer. With the short-circuiting switch closed, the reversing switch is operated several times to remove the effects of any previous magnetization of the yoke 10 and bar 15. The short-circuiting switch is then opened, a single reversal of current between the two predetermined values is made, and the swing of the galvanometer is noted. This gives an indication of the permeability of the magnetic bar 15 from which numerous properties of the material thereof can be deduced.

The control circuit of my invention, having certain advantages over the conventional arrangement above described, is illustrated in Fig. 3. I employ a microammeter 27 having a short-circuiting terminal 28 as a galvanometer. A short-circuiting key 29 normally forms a shunt across the moving coil of the microammeter. The key 29 when depressed to open the shunt, closes a circuit including a lamp 30 positioned to illuminate the scale of the microammeter and a battery 31 for energizing the lamp.

The magnetizing coil 18 is adapted to be connected by a reversing switch 32 to a battery 33 through a rheostat 34 and a shunt 35. A double-pole, double-throw switch 36 is adapted to connect the microammeter to the induction coil 19 when in its upper position. When in its lower position, the switch 36 connects the microammeter across the shunt 35 whereby the rheostat 34 may be adjusted to cause a current of the desired magnitude to flow through the magnetizing coil. This current, of course, must be the same for all tests, in order that comparisons between the results of successive tests may be significant.

The several steps in a typical test will now be briefly explained. With the test specimen in the position shown in Fig. 1, the switch 36 is thrown to its lower position and the key 29 depressed. The rheostat 34 is then adjusted, if necessary, to produce the desired current through the magnetizing coil 18. The switch 36 is then thrown to the upper position. The switch 32 is then reversed several times in quick succession to remove the effects of possible previous magnetization of the specimen and is then left in the upper position. The key is then depressed, the switch 32 is thrown to the lower position and the swing of the microammeter observed. From this observation, the permeability and other characteristics of the specimen relative to a previously selected standard test piece, may be determined.

It will be apparent that the springs 24 normally exert the same pressure constantly on all specimens of substantially the same size. The constancy of the pressure may be checked from time to time by setting aside a particular test specimen and making occasional measurements upon it, other magnetizing conditions being maintained constant. If occasion arises, the screws 25 may be adjusted by loosening the lock nuts 26.

It will be understood from the foregoing description that the invention is characterized by numerous advantages. While the fit between the bar 15 and the holes 14, as shown in the drawing, is not as close as that of the ordinary ground joint, the reluctance of the air gap therebetween is relatively small and, furthermore, is substantially constant for all specimens of about the same size. This makes it safe to draw conclusions from the relative permeabilities exhibited by successive specimens, as shown by the fact that readings for a given specimen are reproduced in successive tests thereon. The construction of the testing apparatus is simple and relatively inexpensive. It permits easy and rapid insertion and removal of the specimen since no screws or clamps have to be tightened or loosened. Since the only air gaps in the circuit when the bar 15 is in place are those between the bar and the wall of the holes 14, a low magnetizing current is sufficient to provide adequate excitation. The magnetizing coil 18 may thus be left permanently connected to the supply battery (except for the momentary interruptions caused by the reversing switch) without excessive drain thereon. Because the exciting current is so low, the change in resistance of the magnetizing coil resulting from the heating thereof is negligible, and the invention may be embodied in easily portable form.

Although I have illustrated and described but a preferred form of the invention, it will be understood that changes in the structure disclosed may be made without departing from the spirit of the invention or the scope of the appended claims. It is not necessary, for example, that the holes 14 be circular or the bar 15 cylindrical, although these shapes are probably the most desirable.

I claim:

1. Testing apparatus comprising a yoke of magnetic metal having spaced legs, said legs having alined transverse openings adapted to receive a specimen bar of magnetic metal, and means effective so to hold said bar removably when inserted through said openings as to establish a low-reluctance magnetic circuit through said yoke and said bar and to maintain substantially the same circuit reluctance on replacement of said bar by a similar bar, thereby imparting significance to a comparison between the magnetic fluxes induced in a succession of such bars, said means including a bore in each leg intersecting the opening therethrough, and a spring-pressed member positioned in said bore, said member normally projecting into the opening and adapted to be displaced by the insertion of said bars.

2. Testing apparatus comprising a yoke of magnetic metal having spaced legs, said legs having alined transverse openings adapted to receive a specimen bar of magnetic metal, and means effective so to hold said bar removably when inserted through said openings as to establish a low-reluctance magnetic circuit through said yoke and said bar and to maintain substantially the same circuit reluctance on replacement of said bar by a similar bar, thereby imparting significance to a comparison between the magnetic fluxes induced in a succession of such bars, said means including a spring-pressed member carried by each leg in such position as to be engaged and displaced by said bar when inserted through the alined openings in said legs.

HAROLD T. CLARK.