May 3, 1949. M. WATTER 2,469,346

FATIGUE TESTING MACHINE

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FIG. 1

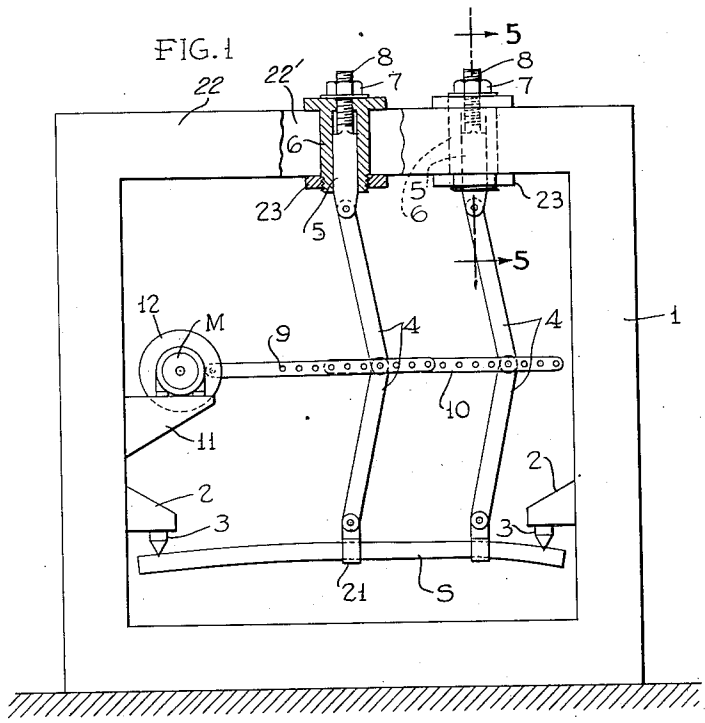


FIG. 2

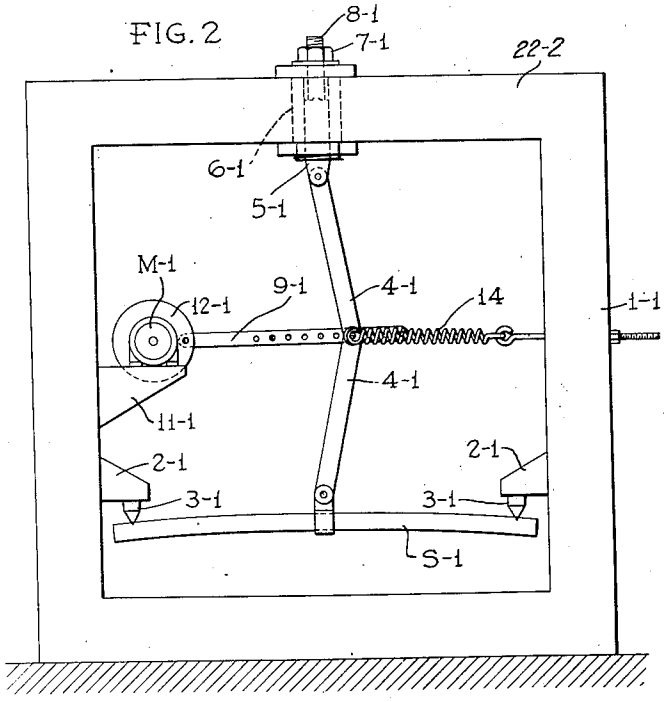
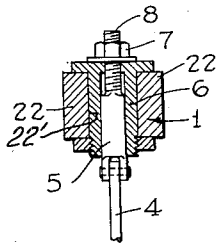


FIG. 5



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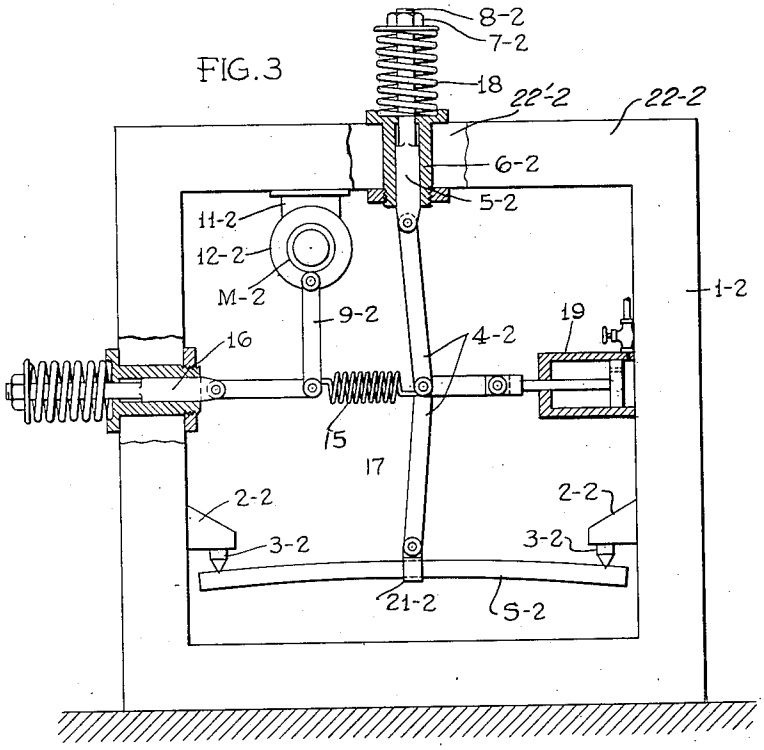
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FIG. 3



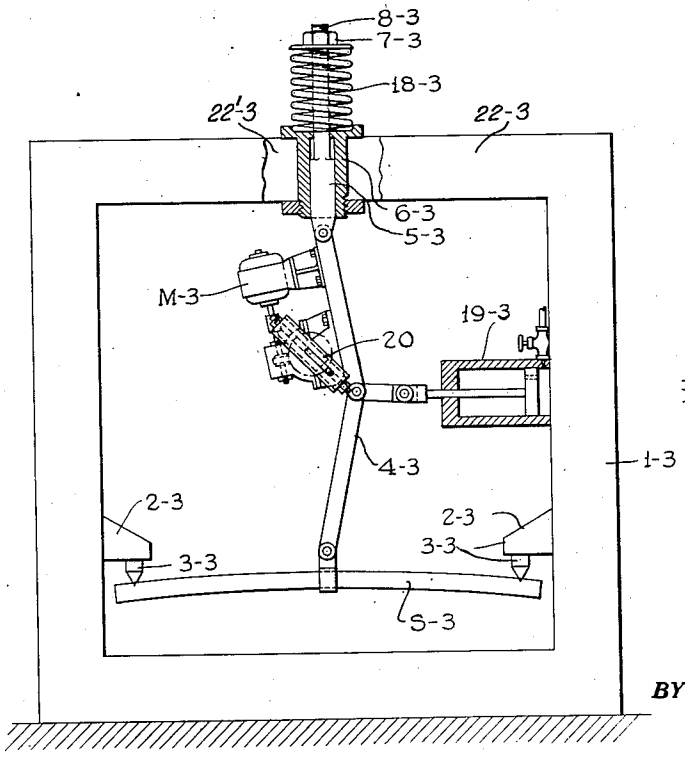


FIG. 4

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FATIGUE-TESTING MACHINE

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Application June 14, 1945, Serial No. 599,437

11 Claims. (Cl. 73—100)

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This invention relates to a fatigue-testing machine and has for an object the provision of improvements in this art.

One of the particular objects of the invention is to provide a testing machine which produces great force for a relatively short distance.

Another object is to provide toggle torsion-applying mechanism which has free and unobstructed action directly upon the specimen.

Another object is to provide load applying mechanism which can be readily pre-loaded.

Another object is to confine vibrations within a fixed frame and to inhibit vibrations externally of the frame.

Another object is to provide means for applying equal or different loads at different parts of a specimen.

Another object is to provide test means of adjustable resonance characteristics and with suitable damping means to keep vibrations below asymptotic limits.

The above and other objects of the invention will be apparent from the following description of an illustrative embodiment, reference being made to the accompanying drawings wherein:

Fig. 1 is a diagrammatic side elevation of a fatigue testing machine embodying the invention;

Fig. 2 is a similar view of a modification in which an elastic element is introduced to modify the applied force;

Fig. 3 is a similar view of a modification in which a double toggle, resonance producing means, and damping means are employed;

Fig. 4 is a similar view of a further modification; and

Fig. 5 is a section taken on the line 5—5 of Fig. 1.

Referring first to Fig. 1, this shows a machine designed to produce forced vibrations, the machine comprising a frame 1 provided with supports 2 with edges 3 for engaging a specimen S, one or more pairs of link toggles 4, slides 5 operating in guides 6 of the frame, adjusting nuts 7 on threaded ends 8 of the slides, drive connecting rods 9, 10 and a drive motor M mounted on a support 11 and operating a crank member such as a disk 12 for operating the rods 9, 10. By this mechanism the specimen S is subjected to bending fatigue. It is placed under initial loadings by the adjusting nuts 7 and thereafter is subjected to repeated additional loadings by the operation of the motor. The load or loads may be applied at any point or points along the specimen by changing the positions of the toggles.

Fig. 2 shows a similar arrangement in which an elastic element, such as a spring 14 is introduced as a means of adjusting the forces applied by the motor. The arrangement still applies pure forced vibration. For simplicity only one toggle is shown but, as before, there may be any

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number at any location and under any pre-loading. Similar parts are designated by the same reference with the suffix "—1" added, as frame 1—1, specimen supports 2—1, specimen engaging edges 3—1, specimen S—1, toggles 4—1, slides 5—1, guides 6—1, nuts 7—1, threaded ends 8—1, connecting rods 9—1, motor M—1, motor support 11—1, and crank disk 12—1.

Fig. 3 shows a modification with resonance and damping variation. Here a double toggle or toggle-on-toggle is employed. Parts which are similar to those of Fig. 1 are designated by the same references with the suffix "—2" added, as frame 1—2, specimen supports 2—2, specimen engaging edges 3—2, specimen S—2, main toggles 4—2, slides 5—2, guides 6—2, nuts 7—2, threaded ends 8—2, connecting rod 9—2 (to motor), motor M—2, motor support 11—2, and crank disk 12—2. The second or auxiliary toggle 15 is connected to the intermediate joint of the first toggle and to an adjustable anchorage 16 on the frame. One or more resilient elements, such as springs 17, may be placed in the auxiliary toggle and a resilient element such as a spring 18 may be placed in the main toggle. A damping device 19 of any suitable character such as a fluid damping device (preferably air) may be connected between the frame and the joint of the main toggle to prevent vibrations reaching uncontrolled limits due to resonance.

By suitably adjusting the toggles and damping device and speed of the motor, the load, amplitude, period of vibration, and period of resonance may be varied between wide limits.

Fig. 4 shows a modification capable of producing effects very similar to those of Fig. 3. Here similar parts are indicated by the same references with the suffix "—3" added, as frame 1—3, specimen supports 2—3, specimen engaging edges 3—3', specimen S—3, toggles 4—3, slides 5—3, guides 6—3, nuts 7—3, threaded ends 8—3, motor M—3, toggle spring 18—3, and damping device 19—3. The motor in this case is mounted directly on the toggle 4—3 together with an eccentric rotatable adjustable weight, as 20, drivingly connected with the motor for producing vibratory forces.

In order to provide great latitude of positional adjustment the specimen may be connected to the toggle by clamps 21 which can be secured at any point along the length of the specimen.

Also, as shown especially in Figs. 1 and 5, the sleeves 6 which carry the other ends of the toggles are mounted in a slot 22' between two frame bars 22, the sleeve being clamped in any adjusted position by nuts 23.

In all forms the amplitude of vibration can be readily changed, in Figs. 1, 2 and 3 by changing the connection of the link 9 to the disk 12, and in Fig. 4 by changing the adjustment of the

weight 20. Adjustment of the damping devices in the resonance forms, Figs. 3 and 4 also produces variations in amplitude.

In setting up for tests the toggles are tightened upon the specimens until approximately the desired load is applied. Indicating strain gages are secured to one of the toggle links or to the specimen and the machine set into operation at the desired speed. Then by stroboscopic illumination the strain gages are read and adjustments made as required.

It will be seen that the apparatus produces very high loadings for very small power; that the toggles are freely supported without sliding friction between their pivots and between their mounting and the specimen; that a great variety of settings and adjustments are possible; that vibration is confined to a heavy frame with a minimum of outside vibration to the building; that resonance may be attained of variable periodicy and amplitude; that improved damping is provided; and that in other ways important improvements and convenience of use are attained.

While certain examplary embodiments have been illustrated and described, it is to be understood that there may be various other embodiments within the limits of the prior art and the scope of the subjoined claims.

What is claimed is:

1. Testing apparatus comprising in combination, a frame, means on said frame for engaging a test specimen, a toggle for applying a load to said specimen, a second toggle connected to the joint of the first said toggle, said second toggle including damping means acting along its longitudinal axis, and power means for applying a load to the joint of the second toggle.

2. Testing apparatus comprising in combination, a frame, means on said frame for engaging a test specimen, a toggle for applying a load to said specimen, a second toggle connected to the joint of the first said toggle, and power means for applying a load to the joint of the second toggle, said toggles including resilient means providing yield along their longitudinal axes.

3. Testing apparatus comprising in combination, a frame, means on said frame for engaging a test specimen, a toggle for applying a load to said specimen, a second toggle connected to the joint of the first said toggle, and power means for applying a load to the joint of the second toggle, said toggles including resilient means providing yield along their longitudinal axes, and said second toggle including damping means acting along its longitudinal axis.

4. Testing apparatus comprising in combination, a frame, means on said frame for engaging a test specimen, means for applying resonant loadings to said specimen, and means for damping said loadings, said load applying means including a toggle, and both said load applying means and said damping means acting on the joint of the toggle.

5. Testing apparatus comprising in combination, a frame in the form of a closed figure, means within said frame for engaging a beam test specimen, a toggle within said frame attached to said specimen, resilient means in said toggle, a second toggle attached to the joint of the first, resilient means in said second toggle, a damping device opposing movements of said toggles, power means connected to the joint of the second toggle, and means for adjusting the tension in both toggles.

6. Testing apparatus comprising in combination, a frame, means on said frame for engaging a test specimen, a toggle for applying a load to said specimen, a second toggle connected to the joint of the first said toggle, and power means for applying a load to the joint of the second toggle, at least one of said toggles including resilient means providing yield along its longitudinal axis.

7. Testing machine comprising a frame, means on said frame for engaging a test specimen, a toggle having one of its ends adapted for engaging the test specimen and its other end attached to said frame, a resilient means at at least one of said ends of said toggle and which means are adjustable for preloading the test specimen, and means imparting vibratory movement to the joint of said toggle for subjecting the test specimen to vibratory stresses.

8. Testing machine comprising a frame, means for engaging a test specimen, a toggle having its one end attached to said frame and its other end adapted for engagement of the test specimen, means for imparting vibratory movement to said toggle and resilient means forming one link of a chain of stress transmitting members, which chain includes as members said frame, said specimen engaging means, the specimen, and said toggle.

9. In a testing machine, a frame, means on said frame for engaging longitudinally spaced points of a test specimen, a toggle extending transversely to the connecting line between said specimen engaging means and having its one end attached to said frame and its other end provided with a clamp for engaging the test specimen between said test specimen engaging means, said second end of the toggle and said clamp being free of engagement with and guidance by said frame, and means for imparting vibratory back and forth movement to the joint of said toggle.

10. In a testing machine according to claim 9, means connecting said first-named end of said toggle to said frame adjustably in a direction parallel to a test specimen engaged by said test specimen engaging means so as to permit the securement of the toggle at different points along the length of the test specimen.

11. In a testing machine, a frame, means on said frame for engaging spaced points of an elongated test specimen, a plurality of toggles arranged parallel to each other between said frame and a test specimen, means connecting the joints of said toggles with each other, and means for imparting a vibratory back and forth movement to the joints of the toggle.

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