

Jan. 7, 1958

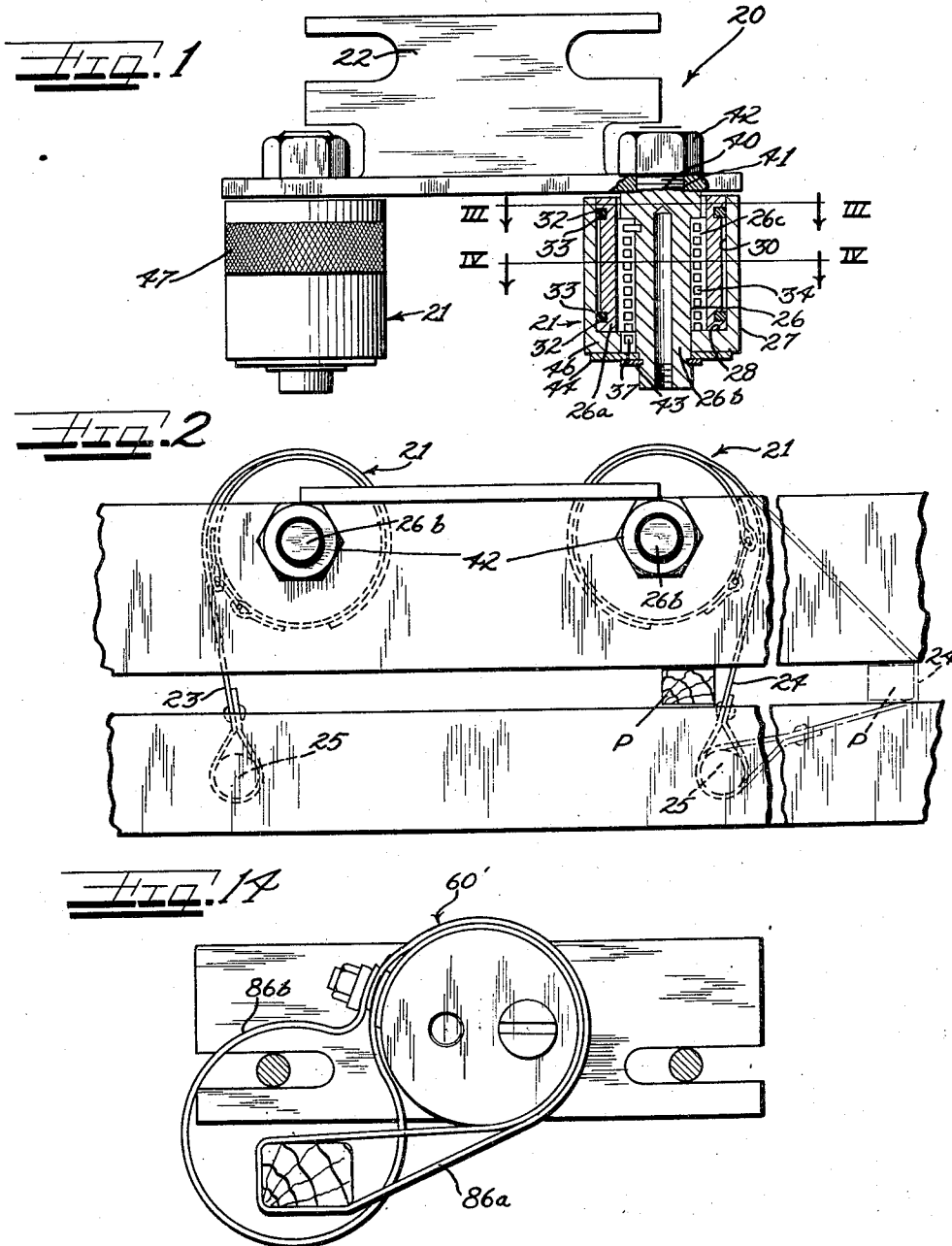
G. H. HUFFERD

2,818,883

LOOM SHUTTLE CHECKING DEVICE

Filed Jan. 6, 1955

4 Sheets-Sheet 1



INVENTOR
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Jan. 7, 1958

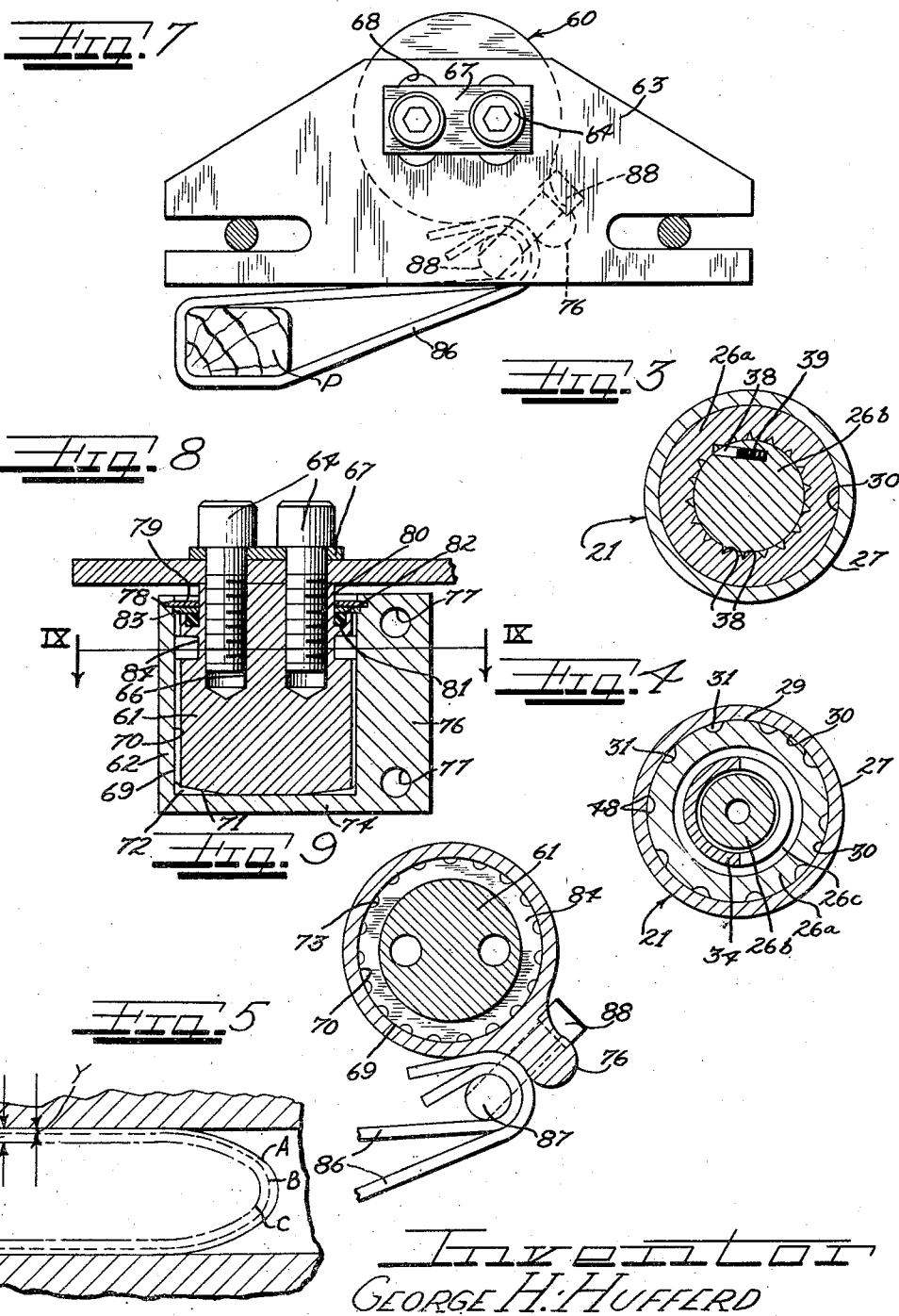
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LOOM SHUTTLE CHECKING DEVICE

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4 Sheets-Sheet 2



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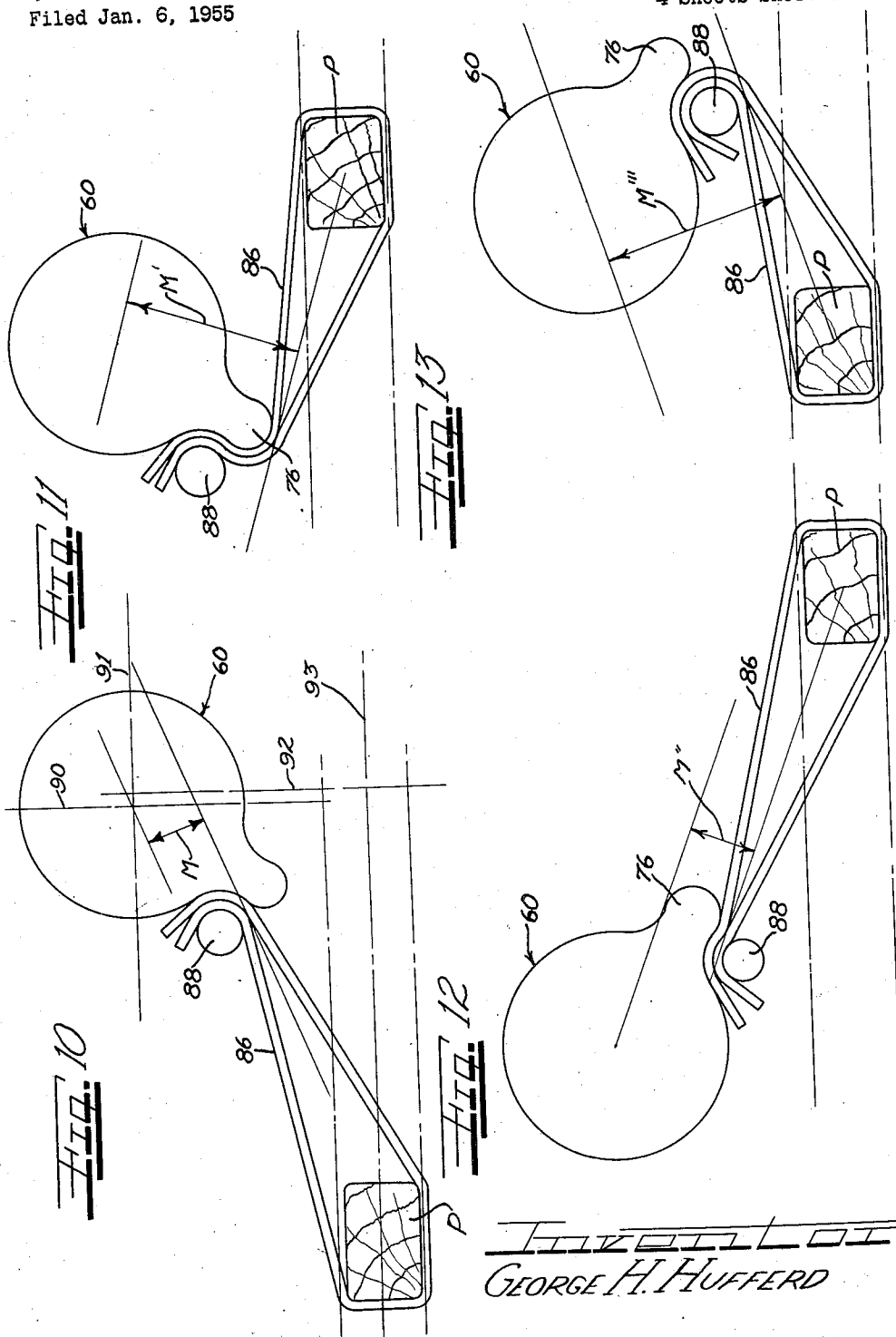
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LOOM SHUTTLE CHECKING DEVICE

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4 Sheets-Sheet 3



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LOOM SHUTTLE CHECKING DEVICE

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4 Sheets-Sheet 4

Fig. 6

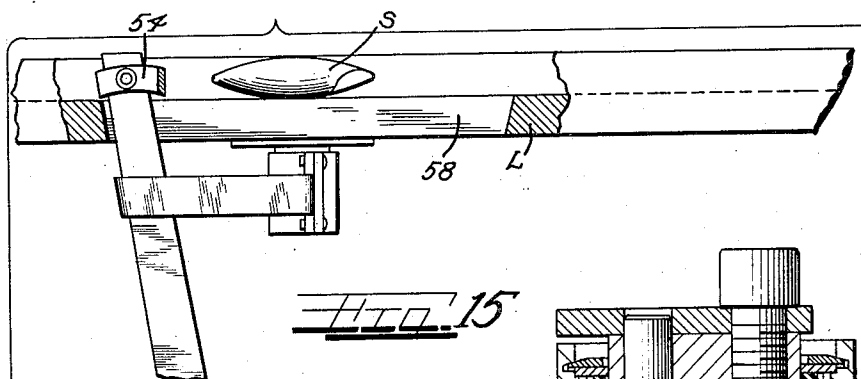
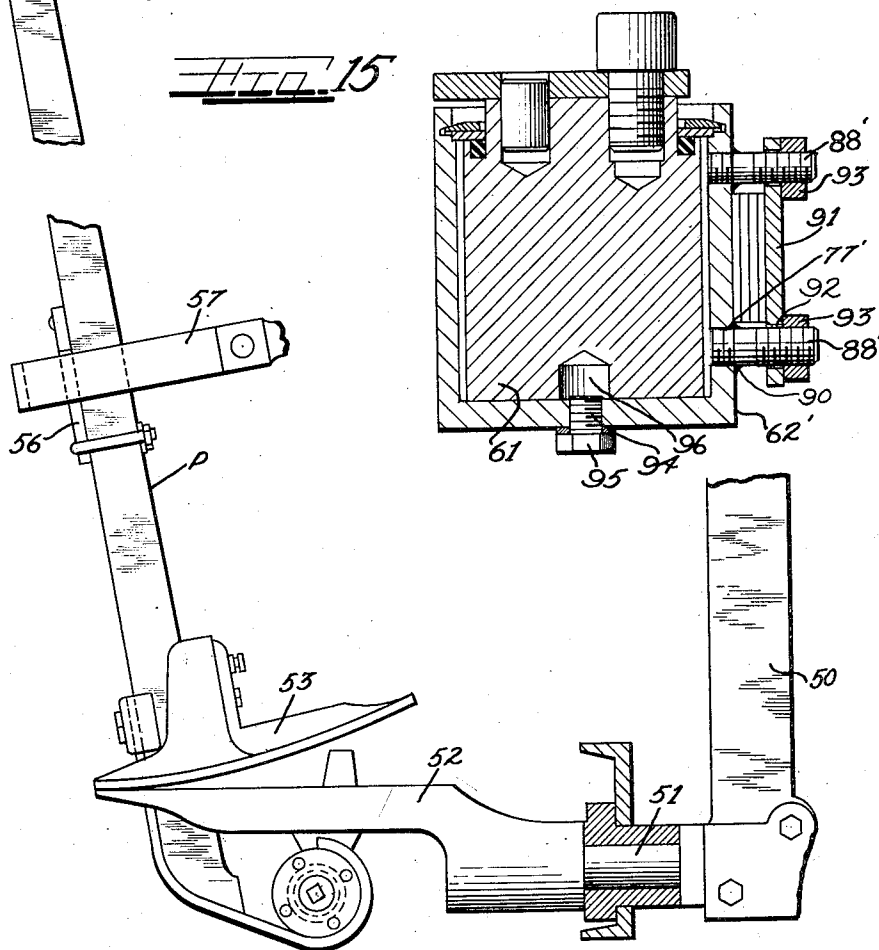


Fig. 15



WITNESSES
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2,818,883

LOOM SHUTTLE CHECKING DEVICE

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Application January 6, 1955, Serial No. 480,127

31 Claims. (Cl. 139—161)

This invention relates generally to loom shuttle checking devices and more particularly relates to a checking device for the picker stick of a fabric weaving loom which exploits the principle of shearing a film of viscous fluid.

It is an object of the present invention, therefore to provide improved checking mechanisms for shuttle looms.

Another object of the present invention is to provide a checking device for the picker stick of a loom which overcomes the deficiencies of the prior art checking devices and which will absorb the forces which are developed during the course of operation of a loom without detriment to the apparatus involved.

Another object of the present invention is to provide a checking device which shears boundary layers of a fluid film.

Yet another object of the present invention is to provide a checking device which will develop a checking function by shearing the boundary layer of a fluid as a function of the kinematic viscosity.

A further object of the present invention is to provide a force resisting mechanism where the dampening force is derived from the shearing of a film of viscous fluid having a thickness of not more than twice the thickness of the boundary layer of the fluid used.

Many other advantages, features and additional objects of the present invention will become manifest to those versed in the art upon making reference to the detailed description which follows and the accompanying sheets of drawings in which preferred structural embodiments incorporating the principles of the present invention are shown by way of illustrative example only.

On the drawings:

Figure 1 is an elevational view with parts broken away and parts shown in cross-section illustrating a dual unit checking device for a shuttle loom provided in accordance with the principles of the present invention;

Figure 2 is an elevational view fragmentary in part and with parts broken away illustrating the checking device of Figure 1 mounted on the lay of a loom and adapted to check the picker stick at the end of its strokes;

Figure 3 is a cross-sectional view taken substantially on line III—III of Figure 1;

Figure 4 is a cross-sectional view taken substantially on line IV—IV of Figure 1;

Figure 5 is a diagrammatic view illustrating well known principles of viscosity occurring in a typical flow of a viscous fluid;

Figure 6 is a fragmentary elevational view with parts broken away showing a picker stick of a fabric weaving loom together with a checking mechanism provided in accordance with the principles of the present invention;

Figure 7 is a plan elevational view with parts removed showing the checking mechanism illustrated in Figure 6;

Figure 8 is a cross-sectional view of the checking device of Figure 7;

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Figure 9 is a cross-sectional view taken substantially on line IX—IX of Figure 8;

Figure 10 is a diagrammatic view of the apparatus of Figures 6-9 where the shuttle is in boxed position ready for the power stroke to begin;

Figure 11 is a view similar to Figure 10 but showing the position of the parts at the end of the power stroke, slack having been taken up in the strap and the checking unit beginning the check of the power stroke;

Figure 12 is a view similar to Figures 10 and 11 but showing the position of the parts at the end of the total stroke;

Figure 13 is a view similar to Figures 10, 11 and 12 but showing the position of the parts at which the picker stick comes to rest immediately before receiving the impact of the shuttle;

Figure 14 is an alternative checking arrangement according to the present invention; and

Figure 15 is a cross-sectional view of the checking device shown in Figure 14.

As shown on the drawings:

Fabric weaving looms are conventionally provided with a pair of picker stick mechanisms which are utilized to propel a shuttle across the lay of the loom at relatively high speed and with a frequency which is measured in terms of the number of "picks" per minute. The picker stick mechanism is located at opposite sides of the loom and each respective picker stick mechanism operates to check the movement of the shuttle to a complete stop, whereupon the picker stick is moved through a power stroke and propels the shuttle to the opposite side of the loom where the picker stick device on the other side of the loom again checks the movement of the shuttle, stops the shuttle and propels the shuttle in a reverse direction.

Since the shuttle is in the nature of a "projectile," and since the shuttle has appreciable weight, the forces which are required to be controlled in the operation of a loom are somewhat unusual. For example, since the shuttle is propelled through the shed, straight line motion must be imparted to the shuttle and, accordingly, the respective picker sticks must be operated by a mechanism which will insure substantial straight line motion of that portion of the stick engaging the shuttle. Furthermore, the actual stroke through which the picker stick moves is only a short distance. Therefore, it is required in a loom that the shuttle be accelerated by a picker stick power stroke of short length. The shuttle must again be checked at the end of its flight in a checking stroke of short length.

It has been observed that the force necessary to stop a picker stick in the same distance as the check stroke is nearly half again as much as that amount of force required to stop the shuttle. This can be partly explained because the shuttle must accelerate the stick before being decelerated by some additional form of checking means, thus losing some energy at impact with the picker stick.

In contemporary looms as presently operated, however, the greatest loss of energy occurs upon entry of the shuttle into a shuttle box located at each respective end of the lay. When the shuttle enters the box, it must move what is known as the binder back against a spring which operates a stop mechanism.

As far as is determinable, it appears that these boxes absorb nearly 90% of the force required to decelerate a shuttle.

Once having delivered a power thrust to a shuttle, the picker stick mechanism must also be checked. For example following the line of power from the stick to the pick cam, there is the power lug, the stirrup lever, the lever shaft and the cam follower lever with the cam follower. All of these components form a part of the picker stick mechanism and having been set in motion during the power stroke of the picker stick mechanism must be

stopped before the picker stick is ready to receive the impact of the returning shuttle on the return stroke.

Many contemporary looms employ friction means to check these forces, although some efforts have been made recently to provide hydraulic checking devices for checking the moving members of a picker stick mechanism.

According to the present invention, the work done in decelerating the shuttle by the shuttle boxes is reduced from 90% to an amount in the order of 20% to 50%. Moreover, the improved form of checking apparatus provided in accordance with the principles of the present invention more efficiently controls the moving members of the picker stick mechanism. By virtue of such provisions, loom operating speeds may be increased, thereby increasing the productivity of the loom.

The improved checking means of the present invention also improves the reliability of the loom by reducing outage and by insuring consistent weaving of high quality cloth.

The checking means of the present invention relates generally to the shearing of fluid films, but specifically exploits the advantageous action which occurs when the "boundary layer" of a fluid is sheared, the boundary layer of the fluid being determined as a function of the kinematic viscosity.

Insofar as the shearing of fluid films is concerned, it appears that persons skilled in the art have clearly established certain relations to be existent. First of all, the force necessary to shear a film of viscous fluid is inversely proportional to the thickness of the film. This force is directly proportional to the kinematic viscosity of the fluid and is also directly proportional to the velocity of the shearing action. Furthermore, the force is directly proportional to the area of the sheared film.

Much of the work that has been undertaken in connection with the shearing of fluid films has been conducted in connection with the study of problems relating to lubrication of bearings. Accordingly, the information obtained was based on the use of fluids of low viscosity.

I have discovered that the above proportions are not valid in connection with the shearing of a boundary layer of fluid. The force resulting from shearing the boundary layer is affected to a much less degree by changes in velocity and fluid viscosity. The boundary layer shearing force varies directly as the approximate square root of the velocity and directly as the approximate fourth root of the viscosity measured in Saybolt standard units (S. S. U.), velocity being measured in inches per second.

Figure 5 is a classic illustration in which the velocity of flow in a tube is shown by the curve A.

It will be noted that this curve A is generally parabolic, thereby illustrating that the fluid in the center of the tube flows much faster than does the fluid lying closer to the wall of the tube. That layer of fluid which contacts the wall of the tube does not move at all and is called the boundary layer.

It appears that the boundary layer varies in thickness in some proportion to the kinematic viscosity of the fluid. In this regard, two other curves B and C in Figure 5 are indicated to illustrate this concept. The curves B and C are greatly exaggerated, however, it can be assumed for purposes of this illustration that curve B represents the characteristics of a fluid having a greater viscosity than that of curve A and the curve indicated at C represents the characteristics of a fluid having an even greater viscosity.

Thus, the thickness of the boundary layer is represented to be "Y" in connection with curve B and "X" in connection with curve C.

According to the present invention, I have provided inner and outer relatively rotatable parts having formed thereon confronting cylindrical surfaces. The outer part preferably comprises a form of a receptacle, thereby per-

mitting the unit to be charged with a fluid having a suitable viscosity.

The radial clearance between the confronting cylindrical surfaces is of such magnitude as to provide clearance for not more than double the thickness of the boundary layer of the fluid used; there being a boundary layer on each of the surfaces.

By relatively rotating the inner and outer parts very favorable checking action is produced. It appears that these favorable results are obtained because only the boundary layer of the fluid is sheared.

In order to prevent destruction of the film by cavitation, one of confronting cylindrical surfaces is provided with a longitudinally extending groove to act as a reservoir.

Referring more specifically to the exemplary structure embodying the advantageous features of the present invention, it will be noted that there is shown in Figure 1 a checking device indicated generally by the reference numeral 20. In this form of the invention, a complete device for checking the shuttle of a fabric weaving loom and for checking the picker stick on the power stroke consists of two separate checking units each indicated by the reference numeral 21 and mounted on a bracket 22 which is bolted to the back side of a lay in such a position that the checking unit 20 will lie adjacent the picker stick and the operative length of stroke of the picker stick with respect to the checking unit 20 will amount to approximately three inches.

In Figure 2, the picker stick is indicated by the symbol P and it will be noted that the picker stick operates at all times between two actuating straps 23 and 24, respectively. Using the plane of orientation of Figure 2, the picker stick P engages the strap 24 at the end of the power stroke and rests against the strap 23 just prior to the approach of the shuttle. The dotted line showing of the picker stick P and the strap 24 indicates the relationship of the parts at the end of the total stroke following the power stroke.

As the stick P progresses in the check stroke, the mechanical advantage of the checking force increases from approximately 0.5:1 to 1.9:1. This means that at the beginning of the check stroke when the velocity of the stick P is the highest, the checking force is low enough that the shuttle will not exhibit a tendency to bounce out of the picker at the moment of impact. As the stick progresses in the check stroke and slows down, the increased ratio of the mechanical advantage serves to increase the velocity of the strap and thus that of the shearing action, so that even as the stick slows down, the force tending to produce such slowing down increases to within about a half an inch of the final check position, where it begins to decrease and finally drops rather abruptly, very close to the end of the stroke. The abruptness of the drop in checking force is partly due to the fact that the force is proportional to the square of the velocity, the term "force" being applied to the force necessary to stop the stick P. Since the force produced by the shearing action in the unit is proportional to the square root of the velocity of the strap, the degree of abruptness is such that a favorable operating action is achieved.

Each of the checking units 21 is identical and, accordingly, a detailed description of one will suffice for purposes of this disclosure.

It will be noted that the unit 21 comprises inner and outer parts, the inner part constituting a body member 26 and the outer part constituting a sleeve-like cup-shaped member 27 providing a receptacle forming bore 28 in which the body member 26 is received.

As will be noted upon referring to Figure 1 in connection with Figures 3 and 4, the body member is provided with a cylindrical surface 29 and the outer member 27 has a bore wall 30 which confronts the outer surface 29, thereby to provide confronting cylindrical surfaces enjoying a diametral clearance in the order of

twice the thickness of the boundary layer of the damping fluid, an amount which by example may lie within the range of 0.002 inch to 0.030 inch.

To prevent destruction of the film by cavitation, the surface 29 is provided with a plurality of longitudinally extending circumferentially spaced grooves 31 forming fluid reservoirs.

At opposite ends of the grooves 31, the body member 26 is provided with circumferential concentric grooves 32 each receiving a sealing member 33 and effecting a seal between the confronting cylindrical surfaces 30 and 29, thereby to confine fluid therebetween.

In this form of the invention, the inner member has a separate sleeve portion 26a and a center stud portion 26b separated by an annular recess 26c. A return spring in the form of a helically coiled torsion spring 34 is located in the recess 26c. One end of the spring 34 is connected as at 36 to the center stud portion 26b, while the other end is connected as at 37 to the outer member 27.

A ratchet device is also provided to effect a resetting of the unit after each operation. As shown in Figure 3, the ratchet assembly includes a plurality of circumferentially spaced notches 38 formed in the sleeve portion 26a of the inner member and the lug portion 26b is recessed to slidably support a ratchet lug 38 biased by a coiled ratchet spring 39. Thus, the sleeve portion 26a rotates in one direction only in relation to outer member 27.

The center stud portion 26b has an upwardly projecting threaded shank 40 which is received in an aperture 41 provided by the bracket 22. A fastening nut 42 retains the center stud portion 26b in firm assembly with the bracket 22.

At the other end of the stud portion 26b, a lock washer 43 is received in a suitable recess provided by the stud portion 26b and retains a thrust washer 44 against the bottom wall 46 of the outer member 27.

Since the stud portion 26b is retained relatively stationary, it will be appreciated that the outer member 27 operates as a movable drum and may be rotated by the unwinding of a corresponding actuating strap 23 or 24 so that a viscous shearing action may occur. Upon resetting, the spring 34 which has been wound up by the rotation of the outer member 27 unwinds, thereby rotating both the drum and the sleeve, as regulated by the ratchet, in order to rewind the actuating strap on the outer member 27.

The actuating straps 23 and 24 are connected at one end to relatively stationary posts 25 forming part of the loom structure. The actuating straps 23 and 24 may be attached to the outer members 27 by any well known friction type buckle. As is shown in this embodiment of the invention, the outer peripheral surface of the outer member 27 is knurled as at 47, thereby to minimize slippage. Each strap 23 or 24 may be attached to the drum by being wound around the outer member 27 over the knurled or roughened portion 47. The acting portion of the strap is then wound around the outer member 27 over that portion of the strap which is fixed to the outer member 27.

By virtue of such arrangement, the two units will rotate in opposite directions. If desired, the straps 23 and 24 may be coated with metal at that portion which contacts the picker stick P in order to provide a low friction surface as well as a better wearing surface. A metal scuff sleeve may also be provided for attachment to the picker stick P for the same purpose.

In filling the unit 20 with viscous fluid, the sleeve portion 26a extends partly out of the outer member 27 far enough so that the upper seal ring 33 is disengaged from the surface 30 of the outer member 27. The fluid is deposited in position below the seal ring 33 and the fixture is preferably evacuated of air to a pressure of about 29 inches of mercury. Upon return of normal air pres-

sure, the fluid is forced to fill the unit completely. The sleeve is then moved into place in the outer member 27 and in so doing, the seal ring 33 is held by friction on the inner face 30 of the outer member 27 to the inner surface of the groove 32. It is contemplated that the seal ring 33 will enjoy a sufficient amount of movement to compensate for the expansion of the fluid film due to rise in temperature.

Upon referring to Figure 4, it may be noted that the edges of the reservoir grooves 31 are chamfered as at 48, which chamfered edges act to lead the fluid into the film. Good results have been obtained by using chamfers in the order of 0.015 to 0.030 inch wide and 30 to 45° measured from the tangent at that position.

Figures 6-13 show an embodiment of the invention wherein a single checking unit may be employed. Referring first of all to Figure 6, it will be noted that the picker stick mechanism of a loom is shown. The lay sword is indicated at 50 and at the bottom thereof is indicated the rock shaft 51 to which the picker foot platform 52 is connected. The picker stick P has a picker foot 53 connected at the bottom end thereof engaging the picker foot platform 52 in order to impart substantially straight line motion to the picker 54 adjacent the top end of the picker stick P.

A power lug 56 is connected to a medial portion of the picker stick P and the power lug strap 57 engages therewith to deliver the force necessary to operate the picker stick.

The lay of the loom is indicated at L slotted as at 58 to accommodate the end of the picker stick P. It will be understood that the usual shuttle box is provided at opposite ends of the lay L and as shown in Figure 6, a shuttle S is actuated across the lay L by the picker stick mechanism.

In this form of the invention, the checking unit is indicated generally at 60 and has an inner part 61 and an outer part 62, the inner part being secured in firm assembly to a bracket 63 by means of a pair of bolts 64 engaged with threaded recesses 66 formed in the inner part 61. The bolts 64 engage a retainer plate 67 and pass through slotted openings 68 formed in the bracket 63.

The inner part 61 comprises a generally cylindrical member having a cylindrical peripheral surface 69 closely confronting a corresponding peripheral surface 70 formed in the bore wall of the outer member 62.

The end wall 71 of the inner member 61 is curved to provide an annular recess 72 at the ends of a plurality of circumferentially spaced longitudinally extending grooves 73 formed in the surface 69 and constituting reservoir grooves to prevent cavitation of the fluid film between the surfaces 69 and 70 when the inner and outer parts are relatively rotated.

The outer member 62 is generally cup-shaped and has an end wall 74 which confronts the end wall 71 on the inner member 61. The outer member 62 is further provided with a boss 76 formed at one side thereof apertured as at 77 and forming part of a clamping means to which may be attached an actuating strap for the checking device 60.

Adjacent the open end of the bore provided in the outer member 62, there is provided a groove 78 receiving a locking ring 79. The inner member 61 is also recessed as at 80, the recess 80 extending radially inwardly of the inner member 61 and arranged to lie in register with the groove 78, thereby to receive the lock ring 79.

Additionally, the inner member 61 has a longitudinal or axially extending recess 81 which opens into the recess 80 and which is located radially inwardly of the outer surface 69 and the groove 73 of the inner member 61. This recess 81 receives a seal ring 82 and engages the surface provided by a thrust washer 83 retained against the lock ring 79.

In the surfaces 69 and 70 and adjacent the seal ring

82, there is provided a deep groove forming a reservoir for storing an excess of fluid. In this form of the invention, the deep groove is formed in the surface 69 of the inner member 61 and is indicated by the reference numeral 84.

It may be noted that the axial space between the bottom of the outer member 62 and the sealing thrust washer 83 is only slightly greater than required by the length of the inner member 61 occupying the space. Accordingly, when the inner member 61 is assembled in the outer member 62, a viscous fluid having a suitable viscosity for example, a viscosity of 500 to 30,000 centistokes being already charged in the outer member 62, the inner member 61 is forced as closely to the bottom of the outer member 62 as possible. This leaves almost all the clearance at the top of the unit.

The sealing ring 82, which may be of the O ring form, extends out of the groove or axial recess 81 far enough to effect a sealing engagement with the thrust washer 83. As the operating temperature rises and the fluid expands, there is a tendency for the outer member 62 to move axially with respect to the inner member 61, however, if there is any such relative movement, a much greater volume is provided at the bottom by virtue of the curved relationship of the adjoining walls providing the annular recess 72 than is lost at the top of the unit. Thus, fluid expansion is provided for at the expense of only a slightly greater load on the sealing ring 82. The expansion space is obtained by the greater volume based on the total area of the sleeve as compared to the volume lost in the differential area between the seal and the sleeve at the top.

The actuating strap is indicated at 86. In this form of the invention, only a single strap is utilized and the opposite ends are clamped against the boss 76 by means of a clamp pin 87 cooperating with a pair of bolts 88 which are extended through the apertures 77 of the boss 76. Thus, the ends of the strap 86 are connected in firm assembly to the outer member 62 and a single loop is formed which encircles the picker stick P at that portion of the stick immediately subjacent the lay of the loom L.

In Figure 10, the reference numerals 90 and 91 indicate the center lines of the checking unit 60 whereas the center lines with respect to the total stroke of the picker stick P are indicated at 92 and 93, respectively. The slots 68 in the bracket 63 and the cooperation of the bolt 64 with the retainer plate 67 permit adjustment of the checking unit 60 with respect to the center lines 90, 91, 92 and 93. Moreover, the length of the actuating strap 86 may also be adjusted by changing the amount of strap under the clamping pin 88. Accordingly, the moment arm indicated at M can be affected by adjustment of the center line 90 to one side or another as well as by adjustment of the strap length of the strap 86.

The adjustment of the center line 91 would merely correct for inaccuracies in location of the attachment bolts on the loom, thereby to provide proper clearance between the checking unit 60 and the picker stick P.

The picker stick will always assume the positions illustrated in Figures 10 and 12 regardless of the speed. The position illustrated in Figure 11 is fixed as far as possible since this position is largely determined by the pick cam. Thus, these three positions are largely predetermined, while the position illustrated in Figure 13 is controlled by adjustment of the strap. Once this adjustment has been made any shifting of the centerline 90 relative to centerline 92 changes the values of the moment arms M with little, if any, effect on the Figure 13 position. By altering the Figure 13 position the length of the check stroke will be lengthened or shortened as the loom speed is increased or decreased, respectively.

It will be understood, of course, that the viscosity of the fluid will be selected in accordance with a predeter-

mination of the contemplated operating speed of the loom and, accordingly, the only variable required to be regulated by the loom fixer will be the shuttle box adjustments.

In operation, the check stroke begins with a high velocity and a long moment arm, the moment arm being indicated in Figure 13 by the symbol M'''.

As indicated in Figure 10 where the moment arm is indicated by M, the check stroke ends with a low velocity and a short moment arm. Likewise, at the end of the power stroke, the moment arm is indicated in Figure 11 at M', thereby combining high velocity and long moment arm. In Figure 12, the moment arm is indicated at M'', thereby indicating the low velocity and short moment arm existing at the end of the total stroke.

The relationship thus provided tends to produce a more equal retarding force throughout the stroke, thereby contributing to the advantageous results achieved by the present invention.

As indicated previously, it is desirable that the unit have sufficient clearance only to provide for not more than twice the thickness of the boundary layer of the fluid used. To give an illustrative example of the practice of the present invention, good results have been obtained with devices constructed as described and utilizing a diametral clearance between the confronting surfaces in the order of 0.002 inch to 0.015 inch and utilizing a fluid having a viscosity in the order of 8,000 to 30,000 centistokes measured at ambient temperatures. In tests these ranges have been expanded through 0.030 inch and using fluids having a viscosity ranging upwardly from 500 centistokes. It has also been found that even though the temperature of the unit rises appreciably during the continued operation of the loom, the advantageous checking action afforded by the present invention is not materially altered.

It appears that the thickness of a boundary layer of a viscous fluid having a viscosity of 12,500 centistokes is indicated as about 0.0025 inch. Since there is a layer on each surface, the total diametral clearance would be 0.010 inch. Larger clearances, of course may be used with fluids having higher viscosities.

As now operated in most cases the free shuttle velocity varies from 450 inches per sec. to 600 in. per sec. At the moment of impact of the shuttle with the picker this velocity has been reduced in the box to about 300 in. per sec. to 400 in. per sec. These last figures are approximate figures based on calculations which in turn are based on empirical data obtained from operation of the loom itself.

The relative velocity of the film shearing surfaces is determined by the shuttle velocity at the time it strikes the picker, being modified as a function thereof only by the mechanical interrelationship between the shuttle and the checking device. Thus, in the embodiment of Figure 2 the shearing velocity may actually equal or exceed shuttle velocity, while in the other embodiments the shearing velocity may be less than shuttle velocity.

Figures 14 and 15 show a modification in the structure described herein. The device is indicated generally at 60' and corresponds generally to the device 60 as shown in Figures 7-13. The principal difference resides in the utilization of two straps which are attached to the unit at one side thereof, each of the straps having one end secured under a clamp and then encircling the picker stick P. The straps are wrapped around the unit in opposite directions each forming a separate loop and the opposite ends of the strap are also retained within the clamp. Thus, one strap is stressed during the shuttle check stroke and the other is stressed during the stick check stroke. One of the straps is shown at 86a and the other strap is shown at 86b. In this form of the invention, the outer part 62' has a pair of spaced threaded recesses 77' each received a stud 88'. The studs 88' may

be placed in firm assembly with the outer part 62' by means of welding indicated at 90. A retainer bar 91 has through holes 92 and is received on the studs 88' in clamping relationship relative to the straps 86a and 86b. Retainer nuts 93 are threaded on the ends of the studs to fasten the straps in firm assembly with the outer part 62'.

In this form of the invention the outer part is also provided with a bottom aperture 94 normally closed by a plug 95 to facilitate introduction of fluid into the unit. The inner part 61' is recessed as at 96 to provide a clearance for the plug 95.

It will be understood that the checking unit 60' makes use of the same checking forces resulting from the shearing of a boundary layer as that used in the other embodiments described herein.

It may be noted that the present invention effectively utilizes the existing structure on contemporary looms. It is particularly effective, however, in reducing the checking action or checking work done by the shuttle box. By permitting the usual loom components to function without material impairment, the checking unit of the present invention will be reset on the power stroke to proper position for the check stroke.

Although it is contemplated that the inner and outer parts of the checking unit 60 or 60' can be made of the same material, such as aluminum or a similar metal, it is also contemplated within the scope of the present invention to provide inner and outer parts being made of dissimilar metals or even dissimilar materials such as plastic and metal so that each corresponding part will exhibit an appreciably different coefficient of thermal expansion. Under such circumstances, a thinner fluid film is provided at the confronting surfaces at high temperatures accompanying continued operation of the loom. Thus, even under the most severe service conditions, there is an insurance that the advantageous results of shearing the boundary layer are afforded even though the viscosity of the fluid is appreciably reduced by the increased temperature. Moreover, by automatically presenting a thinner shear film as the temperature of the parts increases and the fluid viscosity decreases, a more constant resisting force is provided at any predetermined velocity between the surfaces throughout the range of operating temperatures.

Although various minor structural modifications might be suggested by those versed in the art in connection with the preferred structural embodiments herein described by way of illustrative example, it should be understood that I wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of my contribution to the art.

I claim as my invention:

1. In a loom having a shuttle and a picker stick therefor, the improvement of a checking device for checking the picker stick as it approaches the outer and inner ends of its path of travel comprising inner and outer relatively rotatable parts having formed thereon confronting cylindrical surfaces, said outer part comprising a receptacle and being charged with a viscous fluid having a predetermined viscosity, the diametral clearance between said surfaces being in the order of approximately twice the thickness of a boundary layer of the said viscous fluid thereby to form a fluid film between the surfaces, one of said parts having a plurality of circumferentially spaced longitudinally extending grooves formed in a corresponding one of said cylindrical surfaces, thereby to provide reservoirs for the fluid at the surfaces, sealing means between said surfaces to seal said fluid between the surfaces, means mounting one of said parts stationarily to the loom, and actuating means operatively connected to said picker stick and to the other of said parts for effecting relative rotation between said parts, thereby to shear the boundary layer of the fluid film between the surfaces.

2. A checking device as defined in claim 1, said inner part constituting a stud portion and a sleeve portion and including ratchet means formed therebetween to control relative rotation between the stud and sleeve portions in one direction only, whereby said sleeve portion will partake of unison movement with said outer part in one direction but relative movement between the confronting surfaces will occur when relative rotation in an opposite direction occurs.

3. A checking device as defined in claim 2 and a torsion spring between said stud portion and said outer part and operatively connected between said inner and outer parts to return said parts to a predetermined angularly aligned position upon relative rotation in one direction.

4. A checking device as defined in claim 1, one of said surfaces having a concentric groove formed therein adjacent the sealing means to form a reservoir for storing an excess of fluid.

5. A checking apparatus for the picker stick of a loom comprising a bracket adapted to be connected to the lay of a loom adjacent the picker stick, two separate checking units mounted on said bracket, two separate actuating straps, stop means adapted to be connected to the loom and forming a relatively stationary connecting means for one end of each strap, each of said checking units comprising inner and outer relatively rotatable parts having formed thereon confronting cylindrical surfaces, said outer part comprising a receptacle and being charged with a viscous fluid having a predetermined viscosity the diametral clearance between said surfaces being in the order of approximately twice the thickness of a boundary layer of said fluid thereby to form a fluid film between the surfaces, one of said parts having a plurality of circumferentially spaced longitudinally extending grooves formed in a corresponding one of said cylindrical surfaces, thereby to provide reservoirs for the fluid at the surfaces, sealing means between said surfaces to seal said fluid between said surfaces, said inner part of said unit being connected in firm assembly with said bracket, the other end of each respective strap being connected to the peripheral surface of a corresponding outer part of a corresponding unit, said straps arranged to be engaged by the picker stick during the power stroke and checking stroke of the picker stick, respectively, thereby to actuate a corresponding checking unit by effecting relative rotation between said parts, thereby to shear the boundary layer of the fluid film between the surfaces.

6. A checking apparatus as defined in claim 5, said inner part having a stud portion connected to the bracket and a sleeve portion relatively movable with respect to said stud portion, said inner part further including ratchet means interconnecting said sleeve portion and said stud portion and controlling relative rotation therebetween in one direction only, whereby the sleeve portion will move with the outer part in one direction, but relative movement between the confronting surfaces will occur upon relative rotation in an opposite direction.

7. A checking apparatus as defined in claim 6, and a torsion spring between said sleeve portion and said stud portion operatively connected to said stud portion and to said outer part to return the inner and outer parts to a predetermined angularly aligned position after actuation thereof.

8. A checking apparatus as defined in claim 5, one of said confronting surfaces having a concentric groove formed therein adjacent the sealing means to form a reservoir for storing an excess of fluid.

9. A checking apparatus for the picker stick of a loom comprising a bracket adapted to be connected to the lay of a loom adjacent the picker stick, a checking unit attached to said bracket and comprising inner and outer relatively rotatable parts having formed thereon confronting cylindrical surfaces, and adapted to have formed therebetween a fluid film, one of said parts having a plurality of circumferentially spaced longitudinally extending

grooves formed in a corresponding one of said cylindrical surfaces, thereby to provide reservoirs for the fluid at the surfaces, sealing means between the surfaces to seal fluid in the clearance space, said inner part being connected to said bracket, said outer part having a clamp on the outside thereof, two flexible straps connected to the outer part of said unit, said straps each being connected at one end to said clamp and wrapping around the unit in opposite directions to form separate loops with each strap having the other end thereof connected to said clamp, said loops adapted to embrace a picker stick and being engaged by said picker stick during the power stroke and the checking stroke of the picker stick, respectively, to actuate said checking unit by effecting relative rotation between the parts, thereby to shear the boundary layer of fluid film between the surfaces.

10. A checking apparatus for a picker stick of a loom comprising a bracket adapted to be connected to the lay of a loom adjacent a picker stick, a checking unit attached to said bracket and comprising inner and outer relatively rotatable parts having formed thereon confronting cylindrical surfaces, the diametral clearance between said surfaces being such as to maintain a fluid film of viscous fluid, one of said parts having a plurality of circumferentially spaced longitudinally extending grooves formed in a corresponding one of said cylindrical surfaces, thereby to provide reservoirs for the fluid film, sealing means between said surfaces to seal a viscous fluid film between the surfaces, said inner part being connected to said bracket, said outer part having connecting means provided on the outside thereof, and a strap having the free ends thereof attached by said connecting means to said outer part and having a closed loop adapted to encircle a picker stick, whereby the relative rotation of the parts will check the picker stick at the ends of its strokes by effecting relative rotation between the parts, thereby to shear the boundary layer of fluid film between the surfaces.

11. A checking unit comprising outer and inner parts including a sleeve member having a cylindrical bore closed at one end and open at the other end and a body member received in said bore, respectively, said sleeve and body members providing confronting cylindrical wall surfaces, said sleeve member having a groove formed in the walls of the bore adjacent the open end thereof, said body member having a radial recess in register with said groove and having an axially extending recess opening in the said radial recess, a charge of fluid in said bore forming a fluid film in a clearance between said surfaces formed to a width of approximately twice the thickness of a boundary layer of said fluid, a locking ring received in the said groove and in said radial recess to retain said inner and outer parts in assembly, a thrust washer inwardly adjacent said lock ring extending from the walls of said bore into said radial recess and overlying said axially extending recess, and a rubber sealing ring in said axially extending recess effecting a seal to prevent leakage of fluid from between said inner and outer parts, said inner part having a portion projecting out of said bore whereby said inner and outer parts are adapted to be operatively related to relatively moving parts required to be checked by the shearing of the boundary layer of the fluid film between the surfaces.

12. A checking unit as defined in claim 11, one of said surfaces being longitudinally grooved to provide fluid reservoir means for reducing cavitation of the fluid film.

13. A checking unit as defined in claim 12, one of said surfaces having a concentric groove formed adjacent said sealing ring and forming a reservoir for excess fluid in the unit.

14. A checking unit as defined in claim 11, said inner and outer parts having adjoining end walls formed at the closed end of said bore, one of said end walls being curved to provide an annular recess at the confronting surfaces between the parts.

15. In a loom as defined in claim 1, one of said parts formed of a material having a higher rate of thermal expansion than the other part, the operation of said checking device providing an increase in temperature of the parts and an accompanying decrease in fluid viscosity of the film of viscous fluid, said one part expanding more than the other part per degree of temperature increase to decrease the clearance between the surfaces and to present a thinner film of fluid for shear, thereby providing a more constant resisting force at any predetermined relative velocity of the parts throughout the range of operating temperatures.

16. A checking apparatus for a picker stick of a loom comprising a bracket adapted to be connected to the lay of a loom adjacent a picker stick, a checking unit attached to said bracket and comprising outer and inner parts including a sleeve member having a cylindrical bore closed at one end and open at the other end and a body member received in said bore, respectively, said sleeve and body members providing confronting cylindrical wall surfaces having a diametral clearance in the order of .002 inch to .030 inch, said sleeve member having a groove formed in the walls of the bore adjacent the open end thereof, said body member having a radial recess in register with said groove and having an axially extending recess opening into said radial recess, a charge of fluid in said bore having a viscosity of 500 to 30,000 centistokes at ambient temperatures and forming a fluid film in the clearance between said surfaces, a locking ring received in said groove and in said radial recess to retain said inner and outer parts in assembly, a thrust ring providing a surface and being located adjacent said lock ring, said thrust ring extending from the walls of said bore into said radial recess and providing said surface in overlying relationship relative to said axially extending recess, and a sealing ring in said axially extending recess engaging said surface of said thrust ring and effecting a seal to prevent leakage of fluid from between said inner and outer parts, said inner part having a portion projecting out of said bore and being connected to said bracket, said outer part having connecting means provided on the outside thereof, and a strap having the free ends thereof attached by said connecting means to said outer part and forming a closed loop adapted to encircle a picker stick, whereby the relative rotation of the parts will check the picker stick at the ends of its strokes by the shearing of the boundary layer of the fluid film between the surfaces.

17. A checking apparatus as defined in claim 16, one of said surfaces being longitudinally grooved to provide fluid reservoir means for reducing cavitation of the fluid film.

18. A checking apparatus as defined in claim 17, one of said surfaces having a concentric groove formed adjacent said sealing ring and forming a reservoir for excess fluid in the unit.

19. A checking apparatus as defined in claim 16, said inner and outer parts having adjoining end walls formed at the closed end of said bore, one of said end walls being curved to provide an annular recess at the confronting surfaces between the parts.

20. In combination, a loom having a shuttle and means for checking the movement of the shuttle without rebound by the checking force generated in the checking device comprising inner and outer parts having confronting cylindrical surfaces separated by a film of viscous fluid wherein the checking force is derived from shearing said film during relative movement of said cylindrical surfaces in unison with the checking of the shuttle, one of said parts formed of a material having a higher rate of thermal expansion than the other part, the operation of said checking device providing an increase in temperature of the parts and an accompanying decrease in fluid viscosity of the film of viscous fluid, said one part expanding more than the other part per degree of temperature

increase to decrease the clearance between the surfaces and to present a more constant resisting force at any predetermined relative velocity of the surfaces throughout the range of operating temperatures.

21. In a loom having a shuttle, and a picker stick therefor, the improvement of a force-resisting brake for checking the picker stick as it approaches the outer and inner ends of its path of travel in which the resisting force is produced by shearing the boundary layer of a viscous fluid between two relatively cooperating surfaces operatively moved with respect to one another by the picker stick.

22. A mechanism as described in claim 21 where the thickness of the sheared film is not greater than twice the thickness of the boundary layer of the viscous fluid.

23. A mechanism as described in claim 21 where the resisting force is directly proportional to approximately the square root of the relative velocity, measured in inches per second, of the cooperating surfaces.

24. A mechanism as described in claim 21 where the resisting force is directly proportional to approximately the fourth root of the fluid viscosity, measured in Saybolt standard units.

25. Apparatus for rapidly bringing to rest, without rebound, a projectile-like element projected on a substantially linear path of movement, including means for yieldingly receiving the projectile-like element having motion-converting means for converting the linearly-directed force of movement of the projectile-like element into a torque, and means acted upon by said motion-converting means whereby the active force is derived from shearing a film of viscous fluid between two relatively rotatable cooperating surfaces.

26. Apparatus as described in claim 25 consisting of means whereby the active force is derived from shearing a film of viscous fluid whose thickness is not greater than twice the thickness of the boundary layer of said viscous fluid.

27. A loom having a shuttle, a picker stick therefor, a viscous liquid film shearing unit actuable by the picker stick, the liquid film of said unit having a thickness of not more than twice the thickness of the boundary layer of the viscous liquid.

28. In combination with the picker of a loom and a shuttle which in its flight across the loom strikes said picker, two cooperating surfaces separated by a film of viscous fluid, one of said surfaces free to move in relation to the other and connections from the picker to said free moving surface so as to cause relative movement between the surfaces when the shuttle strikes the picker, thereby shearing the film of viscous fluid whereby the motion of the picker and the shuttle will be checked.

29. A loom having a shuttle, a picker stick therefor, a checking device comprising two closely spaced surfaces separated by a film of viscous fluid cooperating with said stick to shear said film as said stick nears the ends of its path for checking the motion of the picker stick as it moves through predetermined distances at the ends of its path, and permitting free movement of the stick from each end of its path to said predetermined distance.

30. A loom including a shuttle, a picker stick movable along a path to receive the impact of the shuttle at a point intermediate the ends of the path to be moved by the shuttle to an outer end of said path, means cooperating with the picker stick for absorbing the energy of the picker stick including the energy imparted thereto by the shuttle, comprising cooperating surfaces separated by a film of viscous fluid, and means to relatively move said surfaces in unison with said picker stick during the course of travel of the picker stick under the energy of the shuttle to shear the film of viscous fluid thereby absorbing the principal part of said energy and stopping said stick and shuttle at predetermined positions without rebound.

31. A checking device comprising inner and outer relatively rotatable parts having formed thereon confronting cylindrical surfaces, said outer part comprising a receptacle and being charged with a viscous fluid having a predetermined viscosity, the diametral clearance between said surfaces being in the order of approximately twice the thickness of a boundary layer of the said viscous fluid, thereby to form a fluid film between the surfaces, one of said parts having a plurality of circumferentially spaced longitudinally extending grooves formed in a corresponding one of said cylindrical surfaces, thereby to provide reservoirs for the fluid at the surfaces, the edges of said reservoir grooves being chamfered and together with an adjoining wall surface forming means for leading fluid into the film, said chamfered edges having an angle in the order of 30 to 45° measured from the tangent to said corresponding one of said cylindrical surfaces, sealing means between said surfaces to seal said fluid between the surfaces, and actuating means for effecting relative rotation between said parts, thereby to shear the boundary layer of the fluid film between the surfaces.

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