

[54] **DRIVE MEANS FOR WEFT INSERTING APPARATUS FOR A LOOM**

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[58] Field of Search **139/122 R, 1, 127 R**

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[57] **ABSTRACT**

For regulating the operation of a weft inserting apparatus during each cycle of loom operation, a sector lever is positively connected by a gear segment or similar element to the weft inserting apparatus and a linkage assembly is connected to the sector lever for reciprocating a weft inserting member during two-thirds of each cycle of loom operation and, during the remaining one-third of each cycle, retaining the weft inserting member in a position spaced outwardly from the shed of the loom. One end of the sector lever is secured to a fixed support and its other end is free so that during each cycle of operation the lever pivots through an angle in the range of 50° to 70°. The linkage assembly includes a coupling lever attached to the free end of the sector lever and during operation the coupling lever, relative to the sector lever, is disposed in a range of 90° to between 105° and 125°. In addition, the linkage assembly includes a driving lever pivotally connected at one end to the coupling lever and at its other end to a fixed support, a connecting rod connected to the point of pivotal attachment of the driving lever to the coupling lever, and a crank connected to the end of the connecting rod spaced from the coupling lever and the driving lever. The crank is arranged to be driven in synchronization with the main shaft of the loom.

13 Claims, 7 Drawing Figures

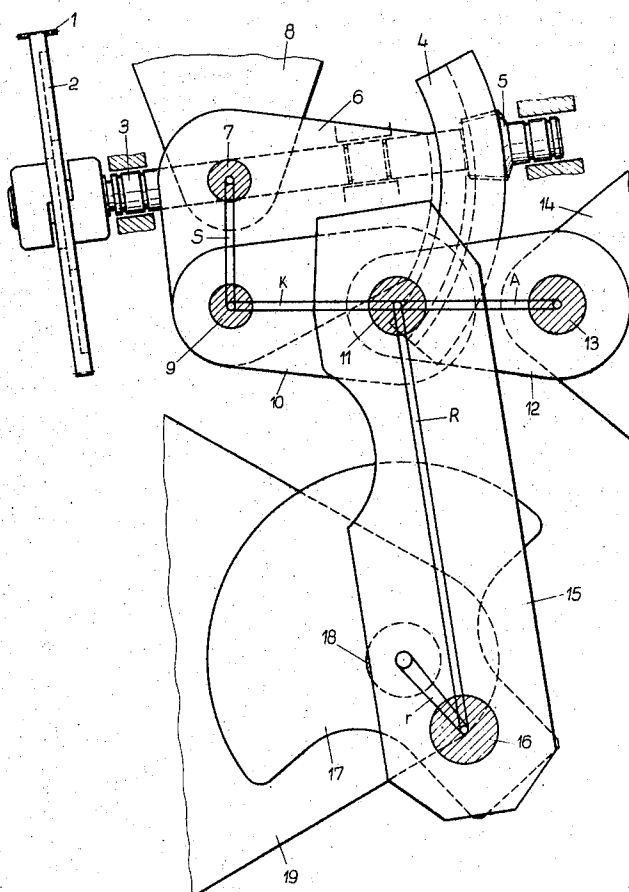
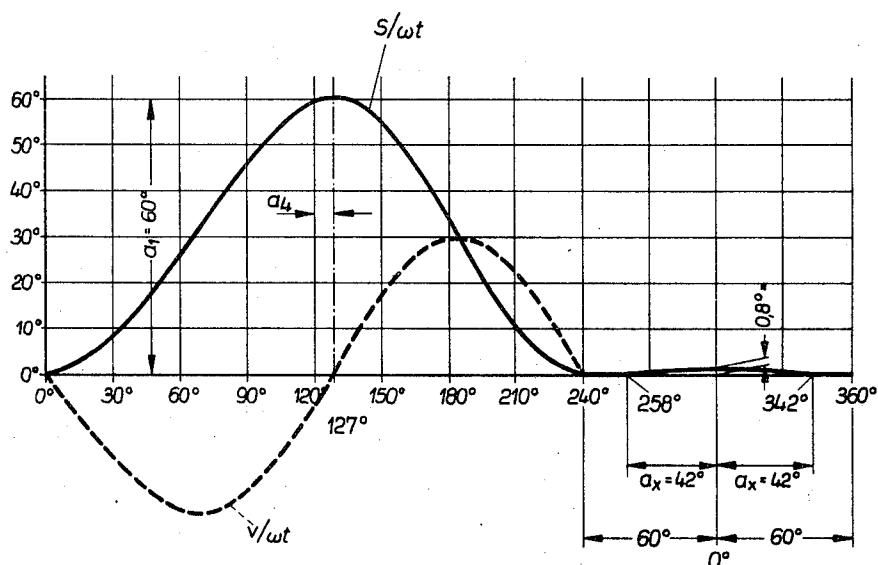
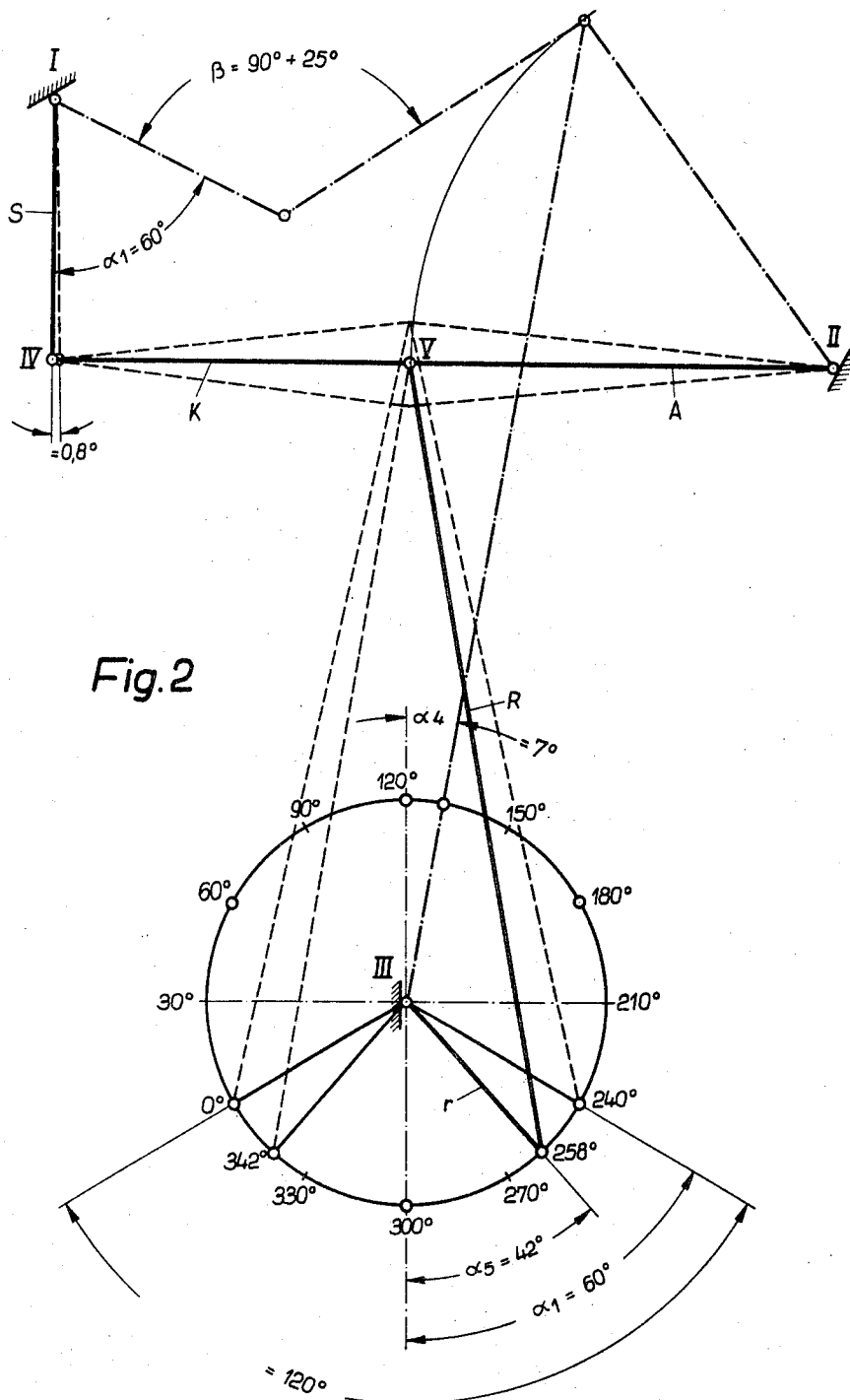


Fig. 1

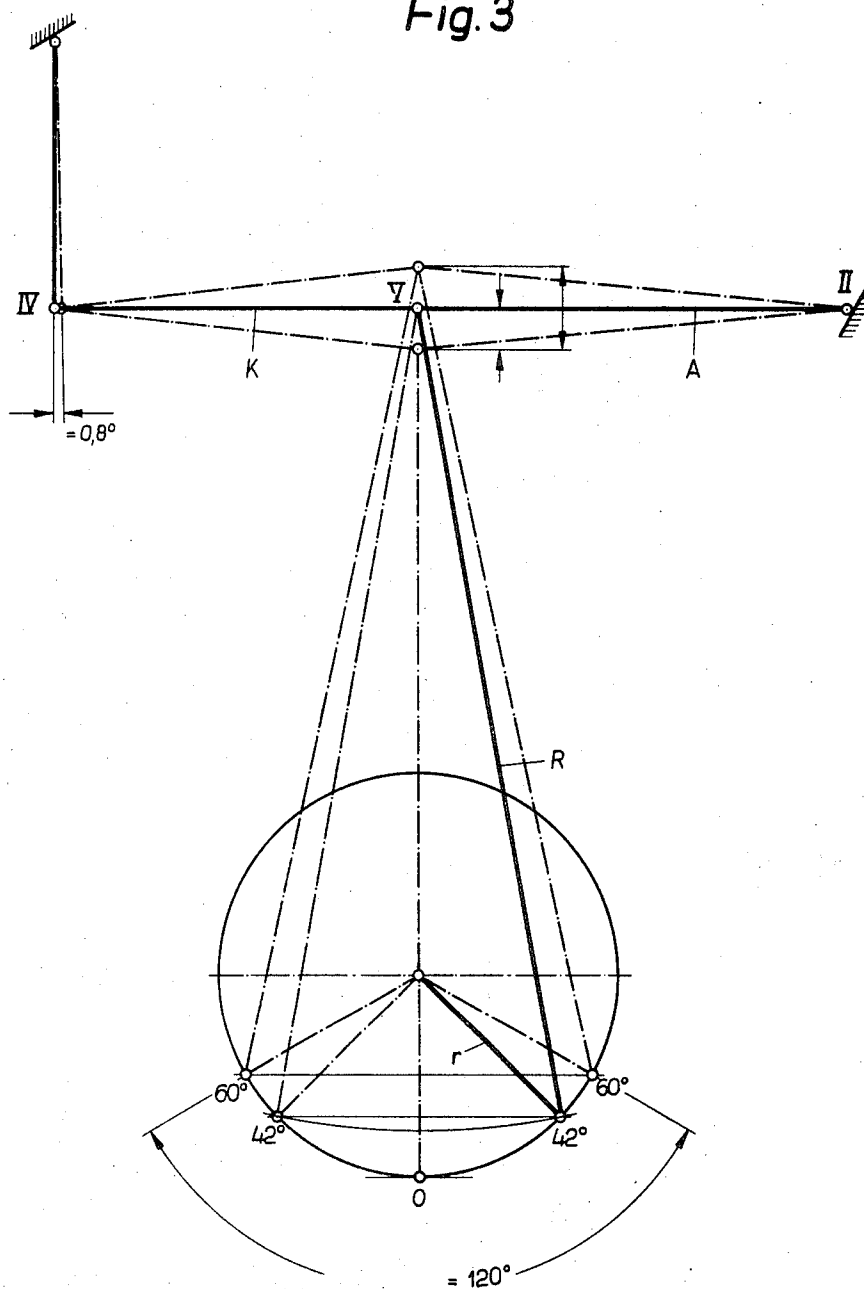


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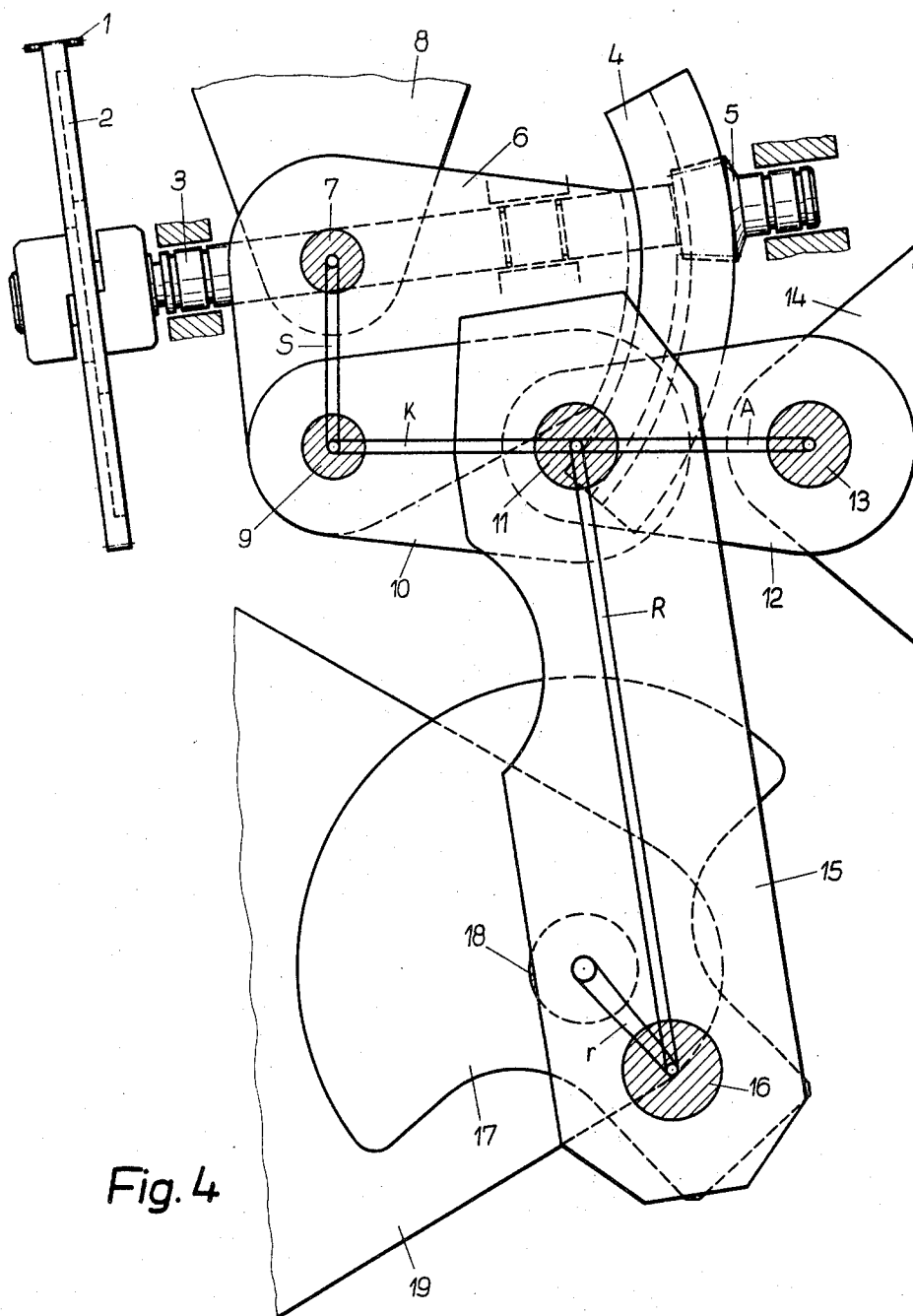


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Fig. 3



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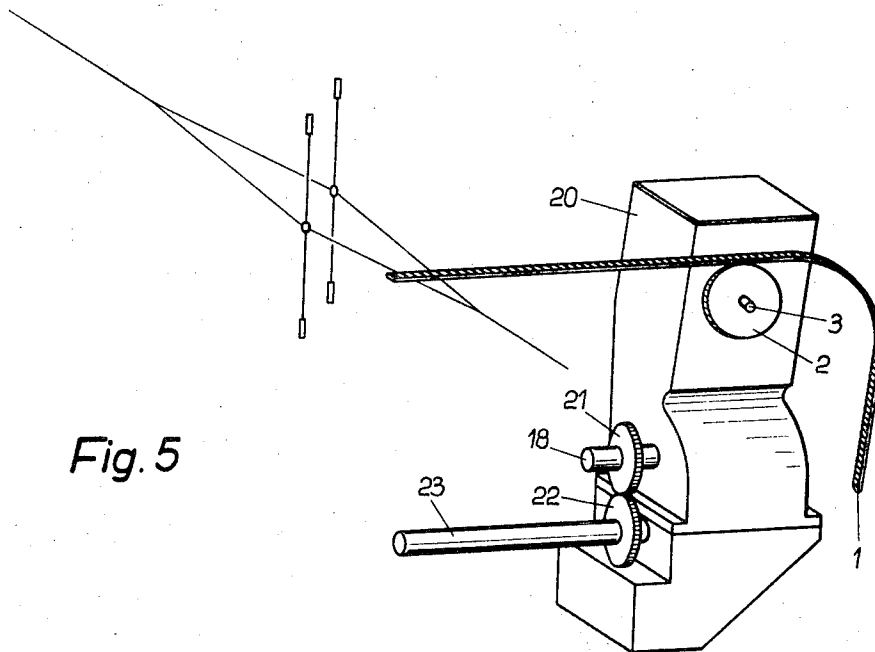


Fig. 5

Fig. 6

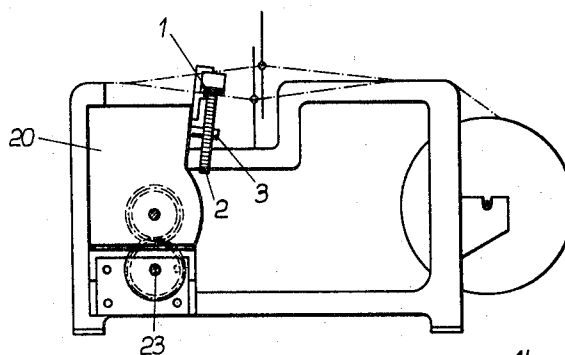
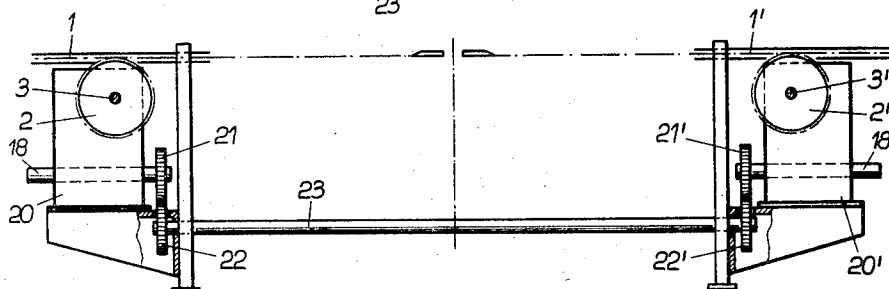


Fig. 7



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DRIVE MEANS FOR WEFT INSERTING APPARATUS FOR A LOOM

SUMMARY OF THE INVENTION

The invention relates to a weft feeder for use in looms provided with grippers. The weft feeder consists of a support provided in the form of a rigid rod or flexible tape reciprocating transversely of the direction of movement of the woven product along the comb and carrying at its top an element for gripping the weft. The weft-feeder performs its weft-feeding movement for about two thirds of the interval in a cycle of the operation of the loom as the comb opens a shed, and for about the other one third of the interval remains in its outer position to pick up a fresh weft as the comb is in the applied position.

Gripper-type looms provided with one or two weft feeding elements are known which are provided at the level of the generally fixed batten which does not swing out. In widely used constructions, two weft-feeding elements are moved in opposite directions to serve as weft feeders and weft collectors or to perform both functions alternately.

The weft-feeding elements may be provided in the form of blunt or sliding grippers; in the former construction, a hairpin shaped weft is fed during the feeding phase to the middle of the shed and is extracted in the form of a single thread during the extraction phase over the second half of the width of the comb, whereas in the latter construction a single-thread feed is carried out.

In both constructions, the weft-feeding elements are in their outer initial positions for the period of application of the comb, that is to say when the last weft introduced is pressed against the edge of the product, in which initial positions the grippers pick up a fresh weft supplied by special devices. The feeding of the weft and the subsequent retraction of the grippers to the initial position take about two-thirds of the interval in a cycle of the operation of the loom, that is to say two thirds of a revolution of the main shaft of the loom, the remaining third being required for the application of the comb and for gripping a fresh weft.

During the feeding process, the weft is drawn off directly from large delivery spools. Looms of this kind are particularly suitable for an alternating feeding of wefts of different colors and qualities. Where particularly delicate yarns are used, the high drawing-off speed starting with a jerk may, however, lead to the thread being subjected to unduly severe tensile stresses and thus to weft breakages as the weft passes through guides, eyelets, brakes, holding devices and the like. In order to prevent this, special preliminary drawing-off and storage devices for the wefts are frequently provided between the delivery spool and the feeder.

In spite of this, these difficulties are intensified when a large number of wefts are to be presented alternately to the weft feeder, since each individual weft requires a special guide and the weft feeder has to have a large radius of movement in view of the fact that it has to pick up various wefts.

Clearly, it is most desirable that the weaving movements and the drive of the weft-feeding elements should be free from vibrations and jerks and that the accelerations and retardations must have a high degree of uniformity, that is to say the greatest possible con-

stancy. In particular, reversal of direction of movement has to be free from jolts and vibrations.

In view of the ever increasing numbers of wefts introduced per minute, it is also necessary, for the purpose of exercising the greatest possible care of the wefts in machines of this kind, to obtain an acceleration of the weft starting as gently as possible during the available period of two-thirds of a weft interval in order to keep the momentarily occurring tensile stresses in the weft at a minimum.

In the known gripper-type looms, the weft-feeding elements are generally driven by cylindrical or flat cam discs; it is known to use so-called grooved cams or open, co-operating pairs of cam discs for this purpose. Drives of this kind do not meet the aforescribed desideratum of careful treatment of the weft upon transmission of the driving power for the forward and return strokes. This applies particularly during operation involving an extended period of time for the feeding phase and a reduced period of time for the return phase, as in the case where the weaving movements are not synchronous with the working strokes of the loom. Owing to the manner characteristic of the operation of cam disc drives, smooth running cannot be ensured during continuous operation, particularly upon reversal of the direction of movement resulting from the transfer of the load from one sliding or roller track to another, because of the occurrence of severe vibrations which lead, in the long run, to phenomena of wear. Furthermore, driving devices of this kind require elaborate measures to be taken in order to counterbalance the cams proper and the levers and in order to ensure as smooth-running an operation as possible.

It is thus an object of the invention to provide weft-feeding apparatus, in which the disadvantages hereinbefore described are reduced or avoided.

According to the invention, there is provided a weft-feeding apparatus for a loom, comprising a weft-feeding element, a sector lever and a connecting rod forming part of a four-bar chain linkage, and means for drivably connecting the connecting rod to the loom to rotate a sector carried by the sector lever to thereby reciprocate a support carrying the weft-feeding element.

If a weft-feeding element is driven by a sector lever of a linkage constructed as a four-bar chain in known manner, the sector lever may swing within an effective sector range of an angle between 50° and 70°, while the angle of application of a coupling lever of the linkage amounts to between 105° and 125°. The end of the coupling lever remote from the sector lever may be coupled to the crank-driven connecting rod which is guided by a driving lever, the crank drive being derived from the main shaft of the loom in synchronism therewith.

The use of the known linkage as a driving means for introducing the driving torque of the sector lever directly into the weft-feeding element affords substantial advantages over the known art. Apart from the simplicity and freedom from wear of such four-bar chains and the simple manner in which the elements thereof may be manufactured, a linkage of this kind affords particularly the specific characteristics of motion which are particularly suitable to meet the requirements.

It has been found that the use of an effective sector range of an angle between 50° and 70° is particularly advantageous for the direct transmission of the angular motion of the sector lever, and elaborate intermediate

transmitting devices may thus be dispensed with. The movement is introduced into the weft-feeding element substantially free from backlash if the torque of the sector lever is transmitted to the weft-feeding element either by a guide or by a rack- and pinion assembly. Functionally advantageous results will be obtained based on the proposed selection of an effective sector range of an angle from 50° to 70° and assuming the angle of application of the coupling lever to be between 105° and 125° ; the coupling lever is then coupled in known manner to the connecting rod guided by the driving lever, and the crank drive is derived directly from the main shaft of the loom. A simple, well-arranged construction of the apparatus comprising a few moved parts is thus obtained the layout and dimensioning of which present no difficulties.

A modification in which the angle of the effective sector range is less than 50° while the advantages of the principle of the construction of four-bar chain according to the invention are maintained, may also be provided. This construction has advantages as well as disadvantages as compared with the preferred construction; it may be considered to be an advantage that a relatively small crank radius may be used whereas, however, the optimum kinematic potentialities afforded by the known four-bar chain fail to become effective. In this construction, an equal working stroke of the weft-feeding element can only be obtained by transmission or, in any case, a greater transmission of the driving movement of the sector lever with the result that the backlashes in the links and toothed wheel gearings used for the transmission (and reduction?) increase.

In accordance with the invention furthermore, it is, in one specific construction of linkage, possible to obtain a stopping period lasting one third of the work cycle interval thus limiting the movement during the so-called static coupling period (Koppelruhe) to an angle of less than 1° , generally to an angle of 0.8° maximum, that is to say during an angle of rotation of the crank of 120° between two extended positions of the driving and coupling levers corresponding to a crank position at an angle of 42° maximum on the one hand and on the other hand, an angle of deflection of the driving and coupling levers corresponding to a crank position at an angle of 0° and 60° respectively, the crank positions being based on a symmetrical position of the crank relative to the driving- and coupling lever assembly. Based on these characteristics of the disposition and angular positions, particularly advantageous conditions with respect to the extent and disposition of the linkage (coupling) stroke result, that is to say, during the stopping period of an angle of 120° , the sector lever is deflected through an angle of less than 1° , it being even possible by exact dimensioning to obtain values of 0.8° and less.

A further requirement with respect to the dimensioning of the linkage resides in the conditions available in the loom for its insertion. In view of the driving forces to be transmitted, the gearing (linkage) should be as small as possible in order to enable the whole apparatus to be accommodated below the warp without obstructing the driving members used for the striking of the comb and the shed formation and without interfering with the position of the main shaft of the machine. It has been found that these requirements may be met in an optimum manner if the ratio between the lengths of the sector lever and of the coupling lever is in the range

1 : 1.3 to 1 : 1.5, the ratio between the lengths of the sector lever and of the coupling lever is in the range 1 : 1.5 to 1 : 1.8, the fixed bearing of the sector lever is disposed on the short cathetus of a right angle triangle, the long cathetus of which is formed by the coupling and driving levers in their extended position, and the fixed bearing of the crank is disposed on the perpendicular erected at the position at which the extended coupling lever and driving lever are hinged together.

Particularly advantageous dimensions may be obtained when the ratio between the lengths of the driving lever (A) and of the connecting rod (R) is less than 1 : 2.5, the preferred ratio being between 1 : 1.8 and 1 : 2.2.

Not only is it desirable to obtain apparatus of small overall dimensions, but also to combine the four-bar chain with the means for guiding the weft-feeding element and the means used for transmitting the weft-feeding movement as compactly as possible by a spatially advantageous disposition and dimensioning.

It is also desirable that the sector lever be coupled to the rod or tape shaped weft-feeding element by positively operating transmitting means. The transmitting means may be provided in the form of a guide by which the sector lever and the weft-feeding element are interconnected; however, the sector lever may also be connected to a pinion or to a gear segment engaging in teeth of the weft-feeding element thus transmitting the torque to the latter.

The linkage comprising the crank mounted on the driving shaft, the connecting rod and the driving, coupling and sector levers as well as the driving shaft may be mounted in a closed gear housing, in which the driving shaft is connected by spur gears to the main shaft of the loom.

Such a combination in a gear housing makes it possible to combine the housing, the driving- and guide means of the weft-feeding element and the weft-feeding element proper in a structural unit representing weft-feeding apparatus in the form of a separate, marketable machine unit. The technical advantages consist in the possibility of removing the apparatus from the machine and replacing it by a reserve unit upon the occurrence of a break-down. Furthermore, the structural unit "gear housing with means for guiding the weft-feeding element" may be so adjusted that the guide means match the respective angle of inclination of the warp threads in the lower shed. In order to ensure optimum utilization of the height of the shed, that is to say in order to keep the size of the shed at a minimum, it is advantageous if this affords the possibility of adjusting the position of the weft-feeding element to the angle of inclination of the lower shed. The application of additional stresses to the warp threads is thus also avoided and the risk of a closed or complete image, presented by delicate products, being effected is thus also reduced.

One or both spur gears used for connecting the main shaft of the loom to the driving shaft of the weft feeder may be provided with a slightly convex special teeth in order to permit of a slight axial inflection of the driving shaft and thus of the whole apparatus, including the guide means for the weft-feeding element, relative to the main shaft of the loom and relative to the comb.

This measure is particularly advantageous where the weft-feeding element consists of a flexible tape which in modern looms, particularly those in which fabrics of

substantial width are woven, is given preference over rod-shaped and thus rigid gripping elements. As a result of the inclined shed, such gripping elements in the form of tapes tend to slide off laterally in the direction of the comb even before reaching the end position of their working stroke with resultant damage to the reed of the comb. This applies particularly to looms provided with combs of a substantial width, particularly when only one weft-feeding element passing through the whole shed is available and the weft is drawn-off on the other side of the loom.

Over and beyond this, in looms in which two weft-feeding elements in the form of tapes are provided, the further risk has to be taken into account that a reliable transfer and picking up of the weft in the middle of the woven product cannot be ensured with the necessary reliability of operation.

The risk is avoided, or at least reduced to an extent consistent with the required reliability, if the direction of the flexible weft-feeding elements can be slightly deflected from the path of the weft. The extent of deflection required may vary according to the material to be processed, the closeness of the fabric, the tension of the warp, the width of the fabric and the like, and according to the angle of the lower shed determined thereby.

The weft-feeding element forming a closed gear unit including the means used for guiding the weft-feeding element, for example the tape wheel in a weft-feeding element provided in the form of a flexible tape, as made possible by the means provided according to the invention, may be perfectly adjusted to the spatial and structural conditions obtaining in gripper-type looms, and may, moreover, be adjusted to the respective requirements of the material processed at the time, since the coupling with the main shaft of the machine in the manner claimed, namely by means of spur gears at least one of which has slightly convex teeth, permits of swivelling or tilting the unit in two planes, in which at least the adjustment of the angle of inclination to the reed of the comb can always be carried out under normal conditions of operation.

One embodiment of the invention is hereinafter described by way of example only, with reference to the accompanying drawings, in which

FIG. 1 is a distance-time diagram of the movement of the weft-feeding element represented by angles of rotation;

FIG. 2 shows the construction of a four-bar system according to the invention used for driving the weft-feeding element;

FIG. 3 is a corresponding representation with emphasis on the principle of the function of the static coupling period (Koppelruhe);

FIG. 4 shows by way of example the construction of a weft-feeder unit;

FIG. 5 shows by way of example a structural weft-feeder unit in the built-in position;

FIG. 6 shows a gripper-type loom provided with two weft-feeding units operating in opposite directions; and

FIG. 7 is an end view of the loom shown in FIG. 6.

In the diagram shown in FIG. 1, the angle of the range of action of a sector lever S, assumed to amount to 60° , is plotted on the ordinate. One full revolution of the main shaft of the loom through an angle of 360° forms the abscissa. It will be noted from the diagram that the reciprocating movement of the weft-feeding element proceeds during rotation through an angle of

about 240° , whereas the period in which the element is stationary corresponds to an angle of about 120° .

It will also be noted that the feeding phase (the forward stroke) corresponds to an angle greater than 120° and the period of time thereof is thus extended, whereas the period of the return stroke phase is correspondingly shorter. The disposition and magnitude of the so-called static coupling period (Koppelruhe) is also shown. The curve of the acceleration v/wt is shown in dotted lines. Based on a characteristic of movement of this kind it is the object to form a four-bar chain meeting the geometrical requirements while observing the greatest possible saving in space.

The basic construction of this four-bar chain is shown in FIG. 2. The sector lever S, designed for a range of action of $\alpha_1 = 60^\circ$, is mounted in a fixed bearing I. The driving lever A pivots about a fixed bearing II. One end V of the driving lever A is linked to the coupling lever K and to a connecting rod R, the coupling lever K is linked at IV to the sector lever S. The ratios between the lengths of the sector, coupling and driving levers, and the positions of the bearings thereof are so selected that the angle of application B amounts to $90^\circ + 25^\circ$.

As shown in FIG. 2, the coupling lever K and the driving lever A are linked in the extended position during which the static period of coupling occurs. Assuming the connecting rod R to have the assumed length, and the crank K to be in the assumed position, then the crank is disposed at an angle of α_5 amounting to 42° measured from the perpendicular erected on the pivot V. The angle of rotation of the coupling stroke of 84° extends to both sides of the perpendicular, whereas the total static period of coupling extends through an angle of 60° on each side of the perpendicular and thus amounts to a total of 120° . FIG. 2 also shows the position of the linkage at the maximum angle of deflection of the lever S of 60° , when the connecting rod R forms the angle (α_4 of 7°). This angle corresponds to the asynchronous displacement of the forward and return strokes of the weft-feeding element.

Particulars of the construction of the linkage used for obtaining a static coupling period of 120° while allowing for the spatial and gear conditions hereinbefore referred to, are illustrated in FIG. 5. As a result of the geometrical relationship between the positions of the crank after rotating through angles of 60° and 42° on the circle described by the crank, the length of stroke of the pivot V is substantially the same in both directions based on the extended position of the coupling lever K and of the driving lever A. The dimensional ratios and the positions of the bearing I and II result in a movement of the pivot or hinge point of the order of 0.8° , this being a perfectly adequate static period of coupling for the weft-feeding element during which to pick up the weft.

FIG. 4 shows the construction of the weft-feeder. The weft-feeding element is provided in the form of a flexible tape 1 which is pressed by known means (not shown) against at least a portion of the periphery of the tape wheel 2. The flexible tape is provided with a perforation (also not shown) in which the teeth (not shown) of the tape wheel 2 engage. The tape wheel 2 is mounted on a tape wheel shaft 3 carrying the bevel gear 5 meshing with a bevel gear segment 4. The latter is secured by a bellcrank lever 6 to the sector lever shaft 7 which is in turn rotatably mounted in a fixed bearing 8.

The lever S is formed by the hinge bolt 9 of the bell-crank lever 6 by which it is linked to the coupling lever K formed by a lever 10. The hinge bolt 11 connects the lever 10 to the connecting rod 15. The driving lever 12, which is mounted in a fixed bearing 14, is, however, pivotable by means of the bolt 13.

One end of the connecting rod 15 is connected by the bolt 11 to the coupling lever 10 and to the driving lever 12, its other end being connected to a crank 17 by a crank bolt 16. The crank 17 is mounted on the driving shaft 18 in frame member 19. The dimensioning of the length ratios in the illustrated construction according to the equation.

$S : K : A : R : r = 1 : 1.375 : 1.625 : 3.5 : 0.7375$ results in particularly advantageous conditions being obtained in respect of the space required in a linkage housing 20 of an advantageous construction (FIG. 5) which can be conveniently accommodated in the frame of a gripper-type loom without disturbing the available spatial and dimensional conditions, particularly in view of the remaining moving devices used for the application of the comb and for the formation of the shed, and which may furthermore be coupled simply and conveniently to the main shaft 23 of the loom by the spur gears 21, 22.

Where, as in the case of the construction shown in FIG. 6, weft-feeding devices are provided on both sides it is advantageous, for purposes of synchronization, to synchronize the two linkages 20 by using a special connecting shaft 23.

The weft-feeding are respectively driven by the main shaft 23 of the loom through spur gears 22 and 22', spur gears 21 and 21' and driving shafts 18 and 18'. The linkages, not shown, by which the operating movements are transmitted to the tape-wheel shafts 3 and 3' and thus to the tape wheels 2 and 2', whereby the weft-feeding elements are operated, are incorporated in the linkage housings 20 and 20' respectively.

The linkage housing 20 may be readily tilted and the movement of the weft-feeding element 1 may thus be adjusted to the angle of inclination of the lower shed (FIG. 6).

Spur gears 21 and 21' respectively meshing with spur gears 22 and 22' have convex teeth in order to enable the gear housings 20 and 20' to be tilted lightly about a transverse horizontal axis in the direction of the selvedge as indicated by an arrow in FIG. 7.

What I claim is:

1. Drive means for weft inserting apparatus for a loom, the weft inserting apparatus comprises a support including a weft-gripping element and means for reciprocating said support in the shed of the loom, wherein the improvement comprises means for operating said means for reciprocating said support for providing the weft inserting movement during two-thirds of each cycle of loom operation and during the remaining one-third of each cycle retaining said support in a position spaced outwardly from the shed of the loom, said means for operating said means for reciprocating said support comprises a sector lever, a linkage assembly operatively connected to said sector lever and means for interconnecting said sector lever and said means for reciprocating said support, said sector lever fixed at one point and arranged to pivot during each cycle of operation through an angle of between 50° and 70°, said linkage assembly comprises a coupling lever secured to said sector lever at a position spaced from the fixed point of said sector lever, a driving lever pivotally

connected at one position to said coupling lever and fixed at another position spaced from its connection to said coupling lever, a connecting rod secured to said coupling lever and said driving lever at the position at which said coupling lever and driving lever are pivotally connected, and a crank arranged to be driven in synchronization with the main shaft of the loom and connected to said connecting rod, and during each cycle of operation the angle of said coupling lever relative to said sector lever is in the range of from approximately 90° to between 105° and 125°.

2. Drive means for weft inserting apparatus, as set forth in claim 1, wherein during each cycle of loom operation said sector lever pivots through an angle not exceeding 50°, and said means for reciprocating said support includes gear means in positive operating engagement with said means for interconnecting said sector lever and said means for reciprocating said support.

3. Drive means for weft inserting apparatus, as set forth in claim 1, wherein during the effective static coupling period of said sector lever corresponding to the period during each cycle of operation of the loom when the weft inserting apparatus is in a position spaced outwardly from the shed of the loom, said sector lever has an angular movement of at most 0.8° so that said weft inserting apparatus stops for the purpose of enabling it to pick-up a thread and the static coupling period occurs during an angle of rotation of 120° of said crank between two extended positions of said driving lever and coupling lever corresponding to an angular position of said crank of 42° maximum on the one hand and respectively one deflected position of said driving lever and said coupling lever corresponding to an angular position of the crank of 0° and 60° respectively, on the other hand, the position of said crank being related to a symmetrical position of said crank with respect to said driving lever and coupling lever.

4. Drive means for weft inserting apparatus, as set forth in claim 1, wherein the ratio between the lengths of said sector lever and said coupling lever is in the range of 1:1.3 to 1:1.5 and the ratio between the lengths of said sector lever and said driving lever is within the range of 1:1.5 to 1:1.8 and during the one-third of each cycle when said support is retained in a position spaced outwardly from the shed of the loom said sector lever is disposed at substantially right angles to said coupling lever and said driving lever which forms a axial continuation of said coupling lever.

5. Drive means for weft inserting apparatus, as set forth in claim 1, wherein the ratio of the lengths of said driving lever and said connecting lever is less than 1:2.5.

6. Drive means for weft inserting apparatus, as set forth in claim 5, wherein the ratio of the lengths of said driving lever and said connecting rod is in the range of 1:1.8 and 1:2.2.

7. Drive means for weft inserting apparatus, as set forth in claim 1, wherein said means for interconnecting said sector lever and said means for reciprocating said support comprises a gear segment in positive engagement with said means for reciprocating said support and in direct engagement with said sector lever.

8. Drive means for weft inserting apparatus, as set forth in claim 7, wherein said means for interconnecting said sector lever and said means for reciprocating said support comprises a guide.

9. Drive means for weft inserting apparatus, as set forth in claim 1, wherein said means for reciprocating said support includes a shaft operatively connected to said support, a bevel gear mounted on said shaft, and said means for interconnecting said sector sleeve and said means for reciprocating said support comprises a gear segment having teeth in meshed engagement with said bevel gear.

10. Drive means for weft inserting apparatus, as set forth in claim 1, wherein a closed gear housing encloses said linkage assembly, said linkage assembly includes a shaft connected to said crank for rotating said crank, and spur gears arranged on said driving shaft for engagement with gears on the main shaft of said loom for rotating said crank.

11. Drive means for weft inserting apparatus, as set forth in claim 10, wherein at least one of said gears has slightly convex special teeth for connecting the main shaft of the loom to said driving shaft of said crank, the slightly convex teeth affording a slight axial inflection

of said driving shaft relative to the main shaft of the loom.

12. Drive means for weft inserting apparatus, as set forth in claim 1, wherein said sector lever is a bell crank lever with one arm extending between the position of the fixed connection of said sector lever and the position of said sector lever at its connection to said coupling lever and the other arm extending transversely thereof, a gear segment mounted on the end of said other arm spaced from said one arm, said means for reciprocating said support comprises a driving shaft, a support wheel mounted on said driving shaft, said support trained over said support wheel, a bevel gear positioned on said driving shaft in spaced relationship from said support wheel, and said gear segment disposed in meshed engagement with said bevel gear.

13. Drive means for weft inserting apparatus, as set forth in claim 12, wherein said support is a thin highly flexible tape.

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