Nov. 26, 1940. J. M. NAUL 2,223,330

ELECTROMAGNETIC SEWING MACHINE

Filed Oct. 7, 1939 4 Sheets-Sheet 1

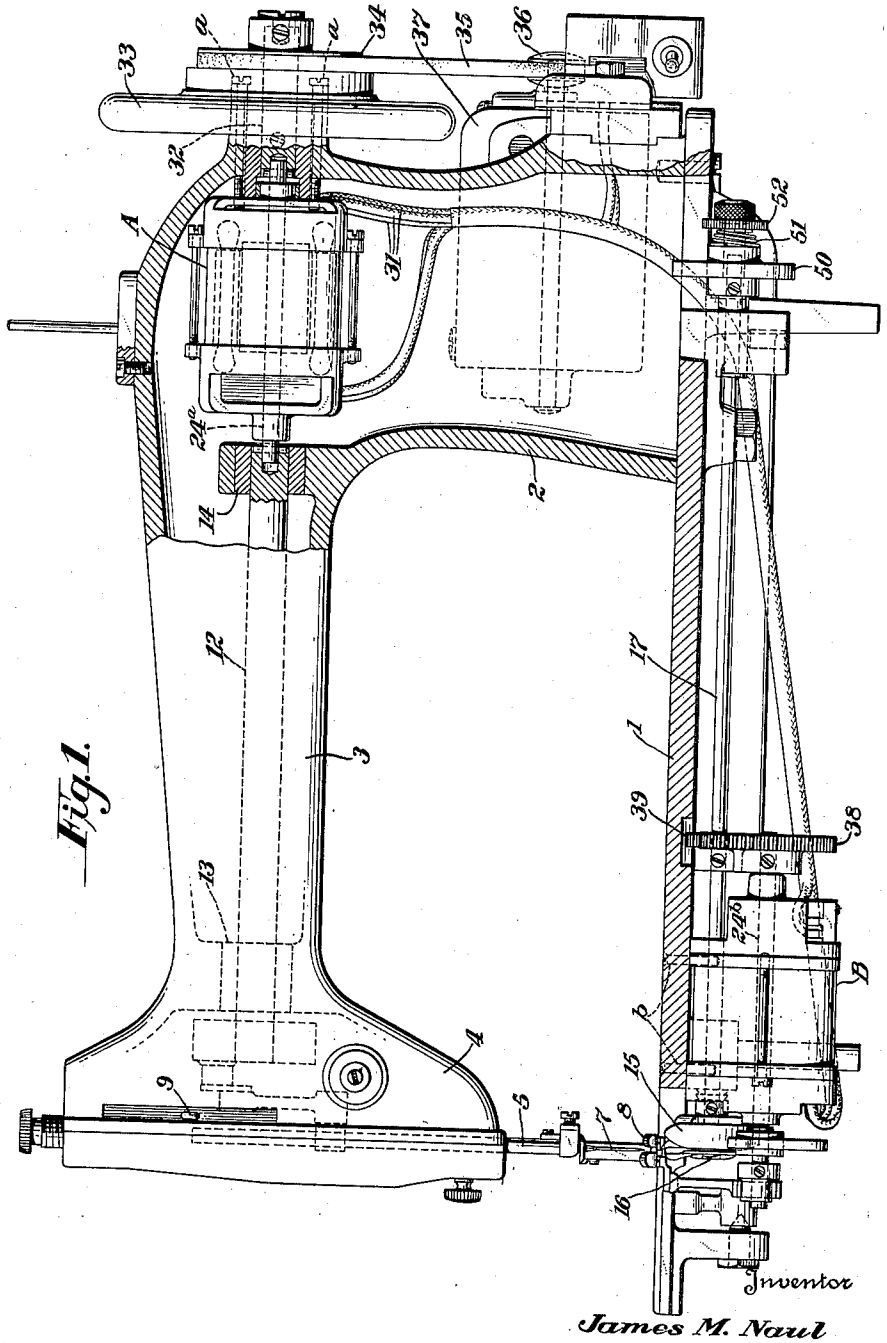

Fig. 1.

Witness:

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ELECTROMAGNETIC SEWING MACHINE

Filed Oct. 7, 1939 4 Sheets-Sheet 2

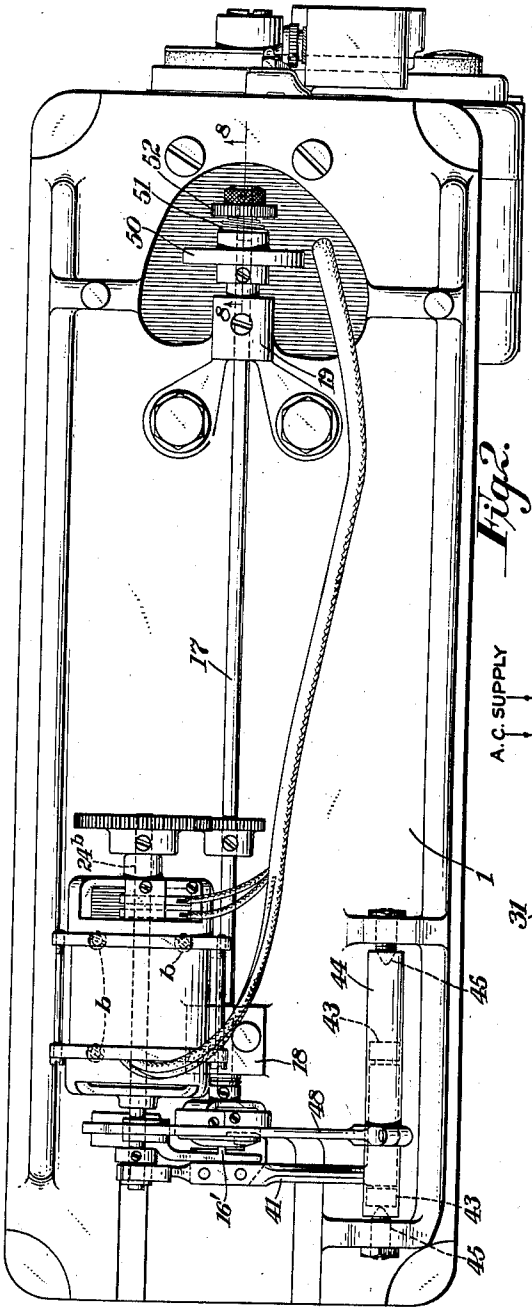

Fig. 2.

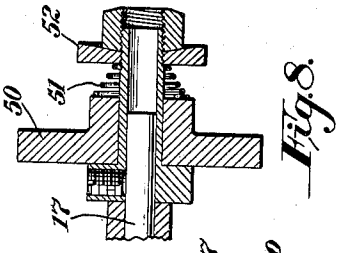

Fig. 8.

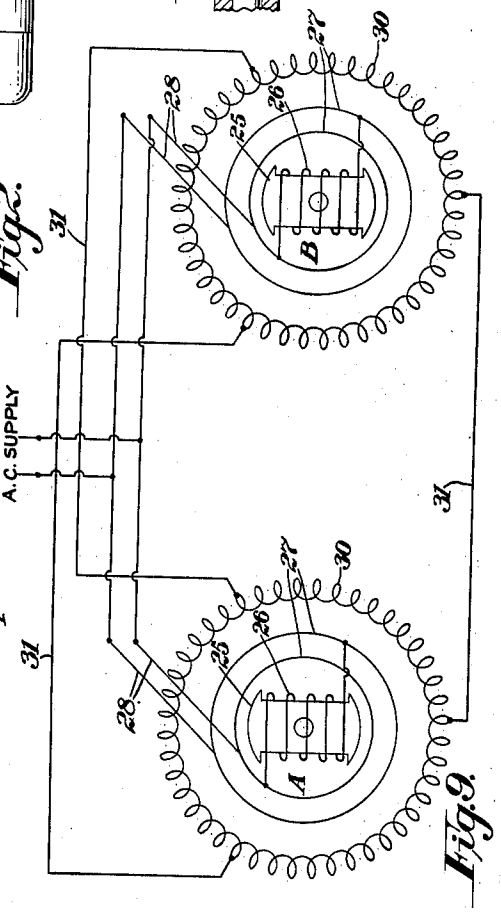

Fig. 9.

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ELECTROMAGNETIC SEWING MACHINE

Filed Oct. 7, 1939 4 Sheets-Sheet 3

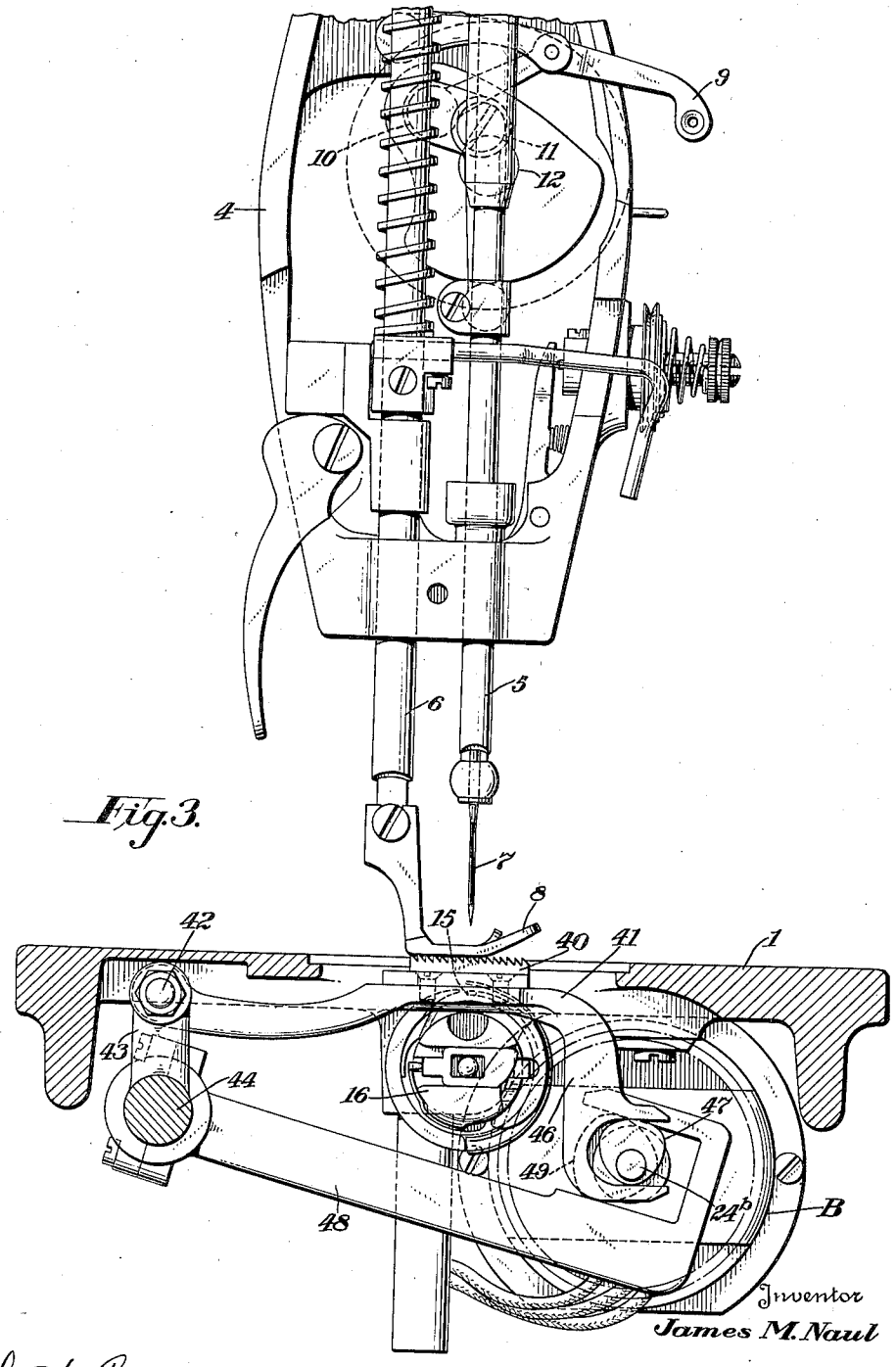

Fig. 3.

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ELECTROMAGNETIC SEWING MACHINE

Filed Oct. 7, 1939 4 Sheets-Sheet 4

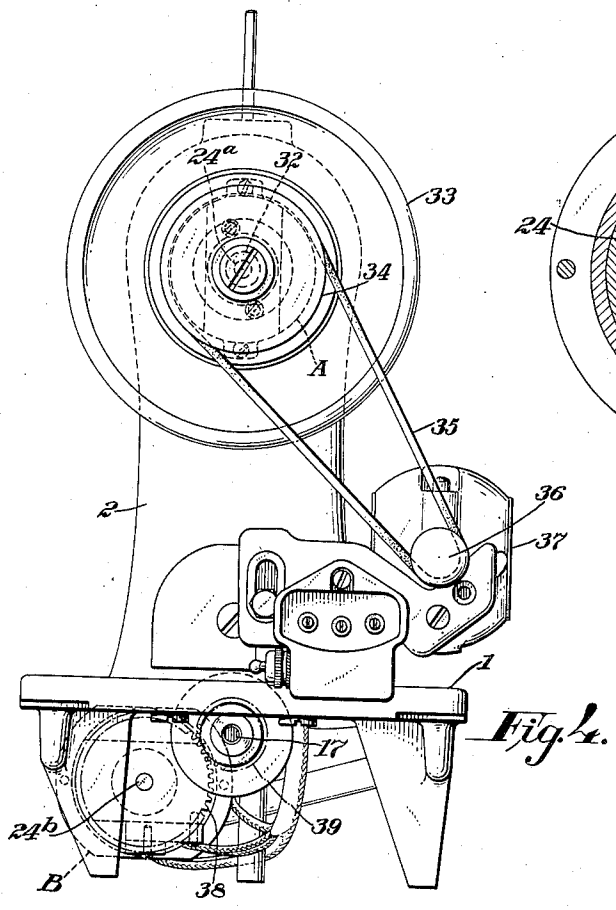

Fig. 4.

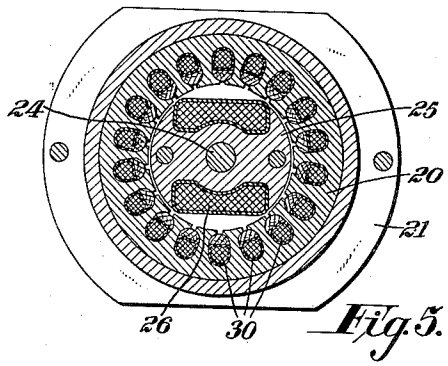

Fig. 5.

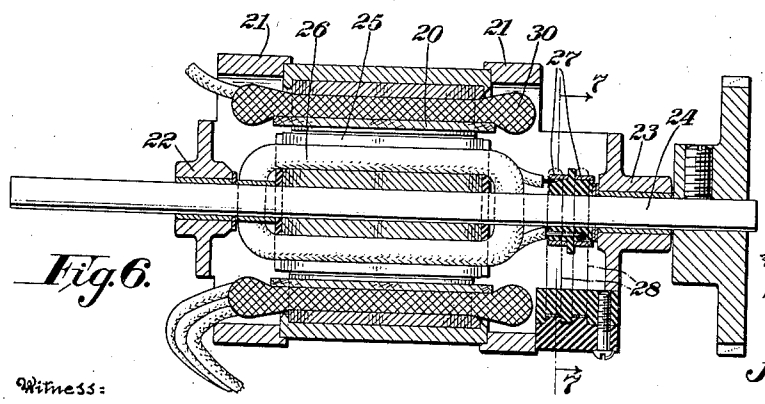

Fig. 6.

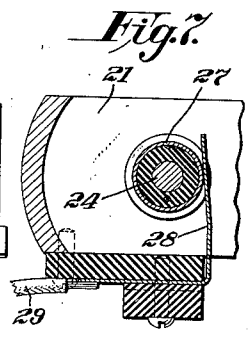

Fig. 7.

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UNITED STATES PATENT OFFICE

2,223,330

ELECTROMAGNETIC SEWING MACHINE

James M. Naul, Fanwood, N. J., assignor to The Singer Manufacturing Company, Elizabeth, N. J., a corporation of New Jersey

Application October 7, 1939, Serial No. 298,351

6 Claims. (Cl. 112—220)

This invention relates to sewing machines and has for an object to provide a practical, quiet, fast and smooth running sewing machine from which all mechanical connections between the upper and lower mechanisms of the machine have been eliminated.

Previous efforts in this direction have involved the use of solenoids or oscillatory electromagnetic devices, the moving elements of which possess considerable inertia and limit the operative speeds of the machines, in addition to making the machines jumpy and noisy in operation.

The aims in view are attained by interconnecting the upper and lower machine mechanisms by means of electrically synchronized rotary devices which maintain a predetermined phase or timed relationship to one another independent of speed, so that the sewing mechanisms, such as the upper or needle-driving mechanism and the lower or loop-taking and/or work-feeding mechanisms operate in properly timed relation to one another without mechanical connection between said upper and lower mechanisms.

The invention will be better understood by referring to the accompanying drawings, of which Fig. 1 is a front elevation, partly in section, of a sewing machine embodying the invention. Fig. 2 is a bottom plan view of the machine. Fig. 3 is a front end elevation of the machine. Fig. 4 is a rear end elevation of the machine. Fig. 5 is a transverse section through one of the electrically synchronized twin rotary devices used to coordinate the upper and lower mechanisms of the machine. Fig. 6 is a longitudinal section through the device of Fig. 5. Fig. 7 is a section on the line 7—7, Fig. 6. Fig. 8 is a section, on an enlarged scale, on the line 8—8, Fig. 2, and Fig. 9 is a diagram of the electrical means used to synchronize and time the mechanisms of the present sewing machine.

The machine is constructed with a frame including the flat bed 1 from one end of which rises the hollow standard 2 of the overhanging bracket-arm 3 terminating in the head 4 which carries the usual reciprocatory needle-bar 5 and spring-pressed presser-bar 6 fitted, respectively, with the needle 7 and presser-foot 8. The head 4 also houses the usual link take-up 9. The take-up 9 and needle-bar 5 are operated in the usual manner by cranks 10, 11 on the top rotary shaft 12 which is journaled in bearings 13, 14 in the overhanging bracket-arm 3.

Complemental to the needle 7 in the formation of stitches is a loop-taker in the form of a conventional two-to-one rotary hook 15 containing the bobbin-thread case 16 restrained against rotation with the hook 15 by the conventional bobbin-case rotation-restrainer 16', Fig. 2. The rotary hook 15 is mounted on the bottom shaft 17 which is journaled in the bearings 18, 19 below the bed 1.

In order for the needle 7 and rotary hook 15 to function to form stitches, a predetermined timed relationship must be maintained between them at all times. In the present machine this predetermined timed relationship is maintained electrically and without mechanical connection between the top-shaft 12 and bottom-shaft 17. Use is herein made of selsyn devices to tie the top and bottom shafts 12 and 17 together in predetermined timed relationship.

The top selsyn A functions as a transmitter of power and the bottom selsyn B functions as a receiver of power from the transmitter.

As selsyns A and B are of identical construction, a description of one will suffice. The Selsyn, Figs. 5, 6 and 7, comprises a laminated stator-core 20 which is held in a frame 21 providing bearings 22, 23, for a shaft 24 carrying the laminated shuttle-shaped rotor core 25 which is excited with alternating current by the two-pole winding 26 the terminals of which are connected to the slip-rings 27 on the rotor shaft 24. Bearing upon the slip-rings 27 are the brushes 28 to which are connected the leads 29 running to an alternating current supply source. The stator-core 20 is wound with a conventional 2-pole 3-phase winding 30. As shown in Fig. 9, the rotors of the selsyns A and B are connected in parallel to the same source of alternating current, while the three-phase windings of the stators of the two Selsyns are connected together by the three wires 31.

The shaft 24a of the top Selsyn A (Figs. 1 and 4) is coaxial with and is keyed to the top rotary shaft 12 and to the short shaft 32 which carries the balance-wheel 33 carrying the belt-pulley 34 connected by the belt 35 to the pulley 36 of a conventional sewing machine driving motor 37.

When the rotors of Selsyns A and B are excited from the same source of alternating current, they immediately take up definite predetermined positions relative to each other and any movement of the rotor of the transmitting Selsyn A is followed exactly by the rotor of receiving Selsyn B, within the torque limits of the devices, entirely independent of speed.

The shaft 24b of the receiving selsyn B carries a gear 38 which meshes with a gear 39 of

half its pitch diameter upon the hook-shaft 17, whereby the hook-shaft 17 is driven at twice the speed of and in time with the top shaft 12. The frame of Selsyn A is secured by screws *a*, *a*, Fig. 1, to the standard 2. The frame of selsyn B is secured by screws *b*, *b* to the under side of the bed 1.

The work-feeding mechanism comprises the feed-dog 40 which is carried by the feed-bar 41 pivoted at 42 on the feed-rocker 43 which includes the feed-rock-shaft 44 journaled on the pintles 45. The feed-bar 41 has its forward end a depending portion 46 which is forked to embrace the feed-lift cam 47 on the bottom rotary shaft 24^b of Selsyn B. Clamped to the feed-rock-shaft 44 is an arm 48 which extends forwardly and is slotted to embrace the feed-advance cam 49 on the bottom rotary shaft 24^b of Selsyn B. The cams 47 and 49 are feed-actuating members and are both mounted directly on the shaft 24^b of Selsyn B.

To minimize hunting tendencies between the Selsyn rotors 25 there is preferably loosely and frictionally mounted on the shaft 17 a small flywheel 50, the frictional drag of which upon the shaft 17 depends upon the pressure thereagainst of the spring 51 whose tension is regulated by turning the nut 52. This slip-jointed flywheel steadies the rotor of the receiving Selsyn B so that it will not hunt or oscillate relative to the rotor of the transmitter A.

If the Selsyns A and B are large enough to possess adequate torque characteristics, the departure from exact phase relationship between the two rotors under variable sewing conditions will not be enough to interfere with the formation of stitches by coaction of the loop-taker or rotary hook with the needle.

The invention is not to be understood as limited to any particular type of sewing machine, either lock-stitch or chain-stitch. It is useful in electrically timing the stitch-forming and work-feeding instrumentalities of a sewing machine without regard to the form of the sewing machine frame and without mechanically interconnecting the mechanisms within such frame. Various modifications may obviously be made in the construction and relative arrangement of parts of the machine shown and described, within the spirit of the invention.

Having thus set forth the nature of the invention, what I claim herein is:

1. A sewing machine having a top shaft, a needle driven thereby, a bottom shaft, loop-taking mechanism driven by said bottom shaft, and electrically interconnected Selsyns each having a stationary and a rotary member, said rotary members being mechanically connected to said top and bottom shafts, respectively, means to drive one of said shafts, and a flywheel frictionally driven by the other of said shafts.

2. A sewing machine having a top shaft, a needle driven thereby, a bottom shaft, a loop-taker driven by said bottom shaft, a pair of alternating current energized, two-pole rotors including shafts mechanically connected, respectively, to said top and bottom shafts, and a pair of two-pole polyphase stators surrounding said rotors and having their winding terminals connected together.

3. A sewing machine having a top shaft, a needle driven thereby, a bottom shaft, a two-to-one rotary hook on said bottom shaft, a pair of alternating current energized, two-pole rotors including shafts the upper one of which is connected to the top shaft and the lower one of which is connected at one end by gears to drive the bottom shaft two-to-one, feeding mechanism including feed-lift and feed-advance eccentrices on the other end of the lower rotor shaft, and a pair of two-pole polyphase stators surrounding said rotors and having their winding terminals connected together.

4. In an electromagnetic sewing machine, top and bottom two-pole polyphase stators having their winding terminals connected together, a pair of alternating current energized, two-pole rotors journaled, respectively, in said stators, a reciprocatory needle, a needle-driving shaft connected to rotate with one of said rotors, a loop-taker complemental to said needle, a loop-taker driving shaft connected to rotate with the other of said rotors, and means to drive one of said shafts.

5. A sewing machine having a needle, a needle-driving shaft, a loop-taker, work-feeding mechanism including feed-actuating members, a Selsyn system including a pair of polyphase stators and a pair of two-pole alternating current energized rotors including rotor shafts journaled in the respective stator frames, one of said rotor shafts being mechanically connected to the needle-driving shaft and the other rotor shaft being mechanically connected to the loop-taker, and feed-actuating members.

6. A sewing machine having a bed and an over-hanging gooseneck, a top shaft in said gooseneck, a reciprocatory needle driven by said top shaft, a rotary loop-taker complementary to said needle in the formation of stitches, a bottom shaft to drive said loop-taker, a transmitting Selsyn motor including a rotor connected to run with said top-shaft, a receiving Selsyn motor having its field frame mounted below the sewing machine bed, a rotor shaft journaled in the field frame of the receiving Selsyn and having its two opposite ends projecting beyond said field-frame, a gear on one end of said rotor shaft connected to drive said loop-taker shaft, a feed-cam mounted on the other end of said rotor shaft, and a feed-bar in said sewing machine connected to receive feed-and-return movements from said feed-cam.

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