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SWAGING MACHINE

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2 Sheets-Sheet 1



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Fig. 2.

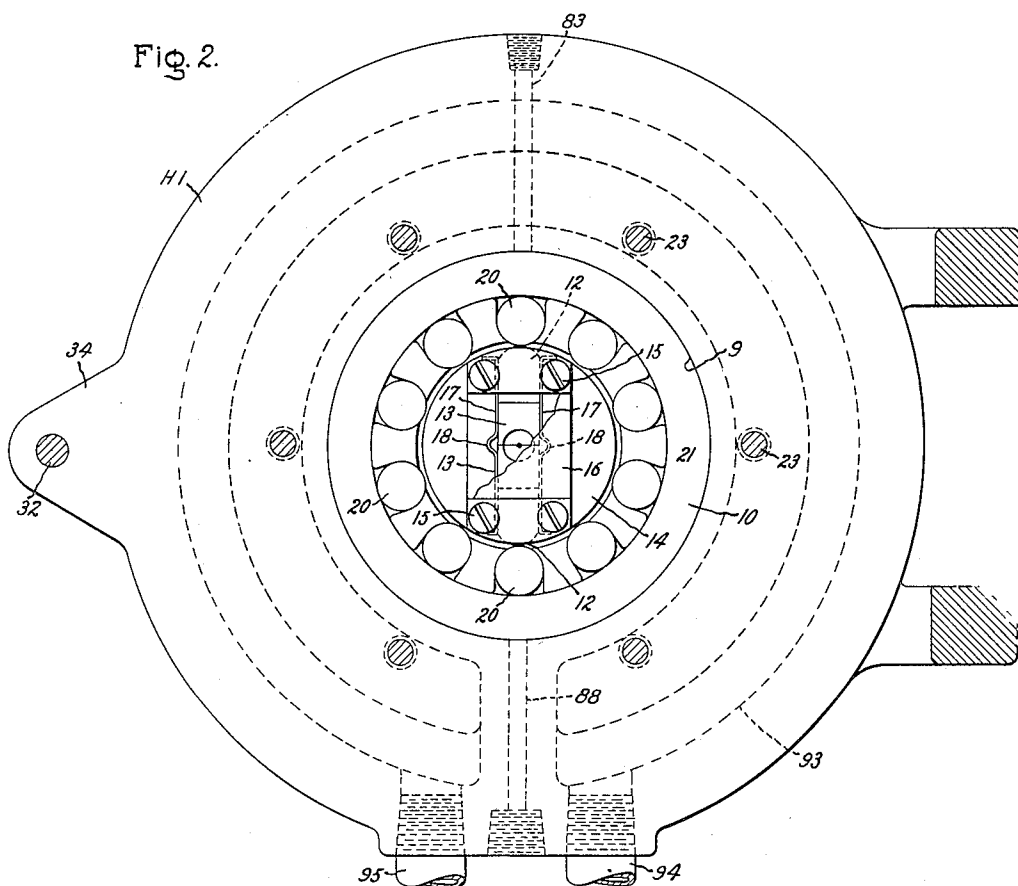
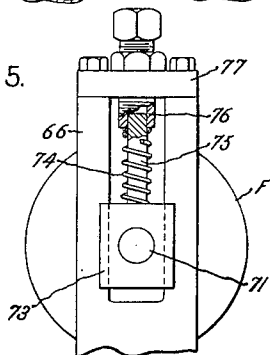


Fig. 5.



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## UNITED STATES PATENT OFFICE

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## SWAGING MACHINE

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3 Claims. (Cl. 78—21)

This invention relates to swaging machines, for example, those machines used for swaging metal rod or wire. The aim of the invention is to provide an improved machine which is convenient and durable and has other desirable features. The preferred type and form of machine here illustrated and particularly described is well adapted for working hot metal and can be used for making wire of refractory metals such as tungsten and molybdenum, which are swaged at very high temperatures. The machine illustrated comprises all necessary features in a single compact unit, including the swaging mechanism proper, a driving motor therefor, and feeding mechanism for feeding the work through the machine, preferably driven (as here illustrated) from the motor that drives the swaging mechanism. Other valuable features include provisions for localizing the absorption of heat from the work and for dissipating the heat that is absorbed,—either from the work or from the driving motor,—and provisions for lubricating the swaging mechanism and the bearings separately. Still other features and advantages will appear from the following description, and from the drawings. However, it is to be understood that various novel features or combinations here disclosed may advantageously be used without some or all of the other features, and in machines quite different from that shown.

In the drawings, Fig. 1 shows a longitudinal vertical section through a machine conveniently embodying the invention; Fig. 2 is a view of the swaging head and mechanism, with parts in front removed and other parts in section, taken as indicated by the line and arrows 2—2 in Fig. 1; Figs. 3 and 4 are opposite end views of the machine; and Fig. 5 is a fragmentary side view of parts of the work-feeding mechanism, one of the parts being partly broken away and in section.

In the machine here shown (Fig. 1), the (electric) driving motor M is compactly and effectively combined with the frame and housing that carries and houses the swaging-die mechanism D and its (hollow) actuating shaft S. The motor M is arranged coaxially with the shaft S and drives it directly. The same frame structure also carries the feed rolls F, F that feed the work or wire W through the machine, and they are preferably driven from the same shaft S through gearing G. The frame structure in question is shown as comprising two end structures H1 and H2, interconnected by an annular shell or casing part C, which serves for enclosing the motor M, arranged between the heads H1, H2. The end structure H1

carries and houses the swaging-die mechanism D, as well as a bearing B1 for the shaft S, and may be referred to as the "swaging head," in accordance with common usage in the swaging art. The end structure H2 carries another shaft bearing B2, and may also be termed a "head." This head H2 is provided with a gear-casing and bracket structure E, which serves for mounting the feed rolls F, F, contains the gearing G, and cooperates with the head H2 in housing the shaft-bearing B2. Preferably, the feed rolls F, F draw the work W through the machine, from left to right in Fig. 1. Irrespective of this, however, the left of Fig. 1 may for convenience be referred to as the "front" of the machine, and the right as the "rear."

The die mechanism D is at the front side of the swaging head H1, in a circular recess 9 formed in the head, Figs. 1 and 2. As shown, the rear wall of this recess 9 is lined with a hardened steel washer 10, in front of which is an annular hardened steel liner 11. The die mechanism D comprises relatively revolving die-block mechanism and actuating devices, Figs. 1 and 2.

In the present instance, the die-block mechanism is revolved by and with the shaft S, and comprises radially acting actuating-blocks 12 and die-blocks 13 in radially extending guideways in a revolving head 14 at the front end of the shaft S,—preferably formed integrally with the shaft. In the present instance, there are two sets of the actuating blocks 12 and die-blocks 13, whose guideways are in radial alignment so as to form one diametral guideway. As shown in Figs. 1 and 2, the actuating blocks 12 and the die-blocks 13 are confined in the diametral guideway in the head 14 by cover plates 15, 15 and 16, the former extending across the outer ends of the guideway and secured to the head 14 by screws, and the latter fitting snugly but not tightly between them, so as to be readily removable. The front end of the head 14 has a shallow diametral recess to accommodate the cover plates 15, 15 and 16,—which are preferably of hardened steel. The other (side and bottom) surfaces of the guideway in the head 14 are faced with facing strips 17 of wear-resistant resilient sheet metal, preferably clock-spring steel. Their opposite ends are bent laterally (outward and rearward) and engaged over corresponding shouldered seats formed in the head 14 at the outer ends of the guideway, so as to hold the facings securely in place,—preferably with a slight snap action when the facings are put in. Outward offsets 18, 18 in the facings 17, 17 at opposite sides of the guideway

engage in corresponding grooves in the head 14, and afford channels through which lubricant and scale may escape from the dies 12, 13 during operation. The facing 17 at the rear or bottom of the guideway has a hole 19 therethrough for passage of the work W.

As shown in Figs. 1 and 2, the actuating devices for the actuating blocks 12 and die-blocks 13 comprise a circular series of (hardened steel) rollers 20 at suitable intervals in the recess 9 of the swaging head H1 around the revolving shaft head 14, housed but free to turn in pockets of a cage 21 (Figs. 1 and 2). The cage 21 and the washer 10 are held in place and clamped against turning by the inner margin of an annular plate 22 secured to the front of the swaging head H1, as by screws 23. The opening in this plate 22 is of such diameter as to afford access to the cover plates 15, 16 and 18 when the front cover 25 is shifted out of the way, permitting the die-blocks 13 to be easily changed whenever desired. As the shaft-head 14 revolves, each actuating block 12 engages each roller 20, which acts as a sort of cam to force the corresponding die-block 13 inward upon the wire W, so that the latter receives a rapid succession of swaging impacts or blows from the die-blocks.

As shown in Fig. 1, the cover 25 has a central guide opening in a plug 26 that has a driving fit in the cover and projects rearward as a central boss thereon, and engages the die-block cover plate 16,—or at least lies close enough to keep it in place as it revolves with the head 14, and to absorb the heat of the die-blocks 13 from it. As best shown in Fig. 3, the cover 25 is hinged to the swaging head H1 by means of hollow studs or pipe nipples 27, 28 mounted in lugs 29, 29 on the swaging head, and having their inner ends screwed fast or engaged fluid-tight in corresponding openings in opposite sides of a lug 30 on the cover. Ordinarily, the cover or "gate" 25 is held "shut" against the front plate 22 of the swaging head H1 by a nut 31 on a screw-stud 32 fixed in a projecting ear 34 on the head H1, which extends through a hollow in a projecting ear on the cover.

To the rear of the die mechanism recess 9 in the head H1 is a bearing and lubricating chamber 35, whose rear wall fits closely but not tightly around the shaft S, with a circumferential groove in the edge of its shaft opening to prevent or minimize leakage of oil. The bearing B1 in this chamber 35 is a roller thrust-bearing that serves to prevent displacement of the shaft S in its longitudinal or axial direction. This thrust bearing B1 is closely adjacent the head 14 and the swaging dies 12, 13, so that thermal expansion and contraction of the shaft S does not shift the dies appreciably. The outer raceway of this bearing B1 fits snugly in an enlargement of the pocket 35 and is secured in place by a plate 37 screwed into the mouth of the pocket. This plate 37 serves as a separating wall or septum between the die mechanism recess 9 and the lubricating chamber 35, and its inner edge fits snugly but not tightly around a reduced shoulder on the shaft hub 14 and has an annular groove in its inner edge surface, to prevent or minimize leakage of oil past the septum. The inner raceway of the bearing B1 fits on the shaft S against its shoulder that cooperates with the plate 37 as just described, and is secured by a nut 38 screwed on the shaft. In the chamber 35, just to the right of the nut 38, the shaft S has an annular

oil throw-off ridge 39, to assist in preventing leakage of oil to the right along the shaft.

The casing C is shown as an annular sheet metal shell with a reduced mid-portion 40, and with ends turned and finished to engage corresponding rabbeted and finished shoulders on the heads H1, H2. The casing C is secured to the heads by bolts 41 that extend through the sides of the reduced mid-portion 40 of the casing shell and into the corresponding ends of the heads. Thus the heads H1, H2 are accurately and rigidly aligned and interconnected by the casing C, though readily separable on occasion. The stationary (field) structure of the motor M, comprising core 42 and coils 43, is attached to the reduced mid-portion of the casing C. The motor rotor (armature) 44 is keyed fast on the shaft S at 45, and is held against a shoulder on the shaft by a nut 46 screwed on it. The nut 46 extends into a bearing and oil chamber 47 in the head H2, and is circumferentially grooved as shown to afford an oil throw-off ridge 48, to assist in preventing leakage of oil to the left along the shaft S. The adjacent sides of the heads H1, H2 are annularly recessed to accommodate the motor coils 43, and the rotor 44 is centrally recessed to accommodate the central portions of the heads, which contain the oil chambers 35, 47. The bearing B2 in the chamber 47 is an aligning roller bearing which does not take any thrust. Its outer raceway fits against a shoulder in the chamber 47 and is secured by a ring nut 49 screwed into the mouth of the chamber. The inner raceway of the bearing B2 fits loosely but without play around the shaft S, so as to allow free longitudinal shift of the shaft through the raceway with temperature changes. The shaft S extends through the head H2 proper and projects beyond it across the gear chamber 50 in the structure E.

The gear casing and bracket structure E is secured to a rabbeted seat at the rear of the head H2 by bolts 51. The gearing G therein is of the helical type, comprising a gear 52 keyed fast on the shaft S at 53 and meshing with a gear 54 keyed fast on a transverse shaft 55 below the shaft S. The transverse shaft 55 is journaled in a boss 56 integral with the side wall of the gear casing, and has a gear 57 keyed fast and secured on its outer end. On the shaft S, to the rear of the helical gear 52, there is a flanged collar or lubricating throw-off disc 58. This flanged collar 58 and the gear 52 are held against a shoulder on the shaft S by a nut 59 screwed on the end of the shaft. In the rear wall of the gear casing, around this nut 59, there is an opening large enough to pass the flanged collar 58, but normally closed by a removable cover plate 60 fitting loosely around the nut 59, and secured in place by screws. In the shaft S there is a thermo-insulative bushing 61 of any suitable material (such as steel or thermo-insulative material) through which the work W travels. While the front and rear ends of this bushing 61 fit closely (but not tightly) in the bore of the shaft S, it is externally reduced throughout most of its length, thus affording a thermo-insulative air space around it inside the shaft. The rear end of the bushing or sleeve 61 has an external flange 62 that is clamped against the end of the shaft S by a guide plug 63 screwed into the nut 59.

It will be observed that the shaft S is largest at its head 14, and thence decreases in diameter toward the right, from one portion to another, 75

making it comparatively easy to assemble the swager.

The feed rolls F, F are mounted (Figs. 1 and 4) on a rearward projecting bracket portion 65 of the gear case and bracket structure E, between upright brackets 66, 66 bolted fast to a base plate 67 which has a groove and feather engagement 68 with the bracket 65 permitting adjustment transversely of the latter, and is normally clamped in position by a screw 69 extending through a slot in the bracket 65 and taking into the base plate 67. The feed rolls F, F are fast on shafts 70, 71 journaled in bearings in the upright brackets 66, 66, and are intergeared to turn in unison by gear-wheels 72, 72 fast on said shafts. While the bearings for the lower shaft 70 are fixed in the brackets 66, 66, those for the upper shaft 71 are in bearing-blocks 73 slidably mounted in vertical ways in the brackets, Figs. 4 and 5. The coacting rolls F, F are yieldingly urged together on the work or wire W by helical compression springs 74 mounted around upright studs 75 on the blocks 73. The upper ends of the springs 74 abut against hollow adjusting screws 76 screwed through the removable upper ends 77 of the guideways 66, and the upper ends of the studs 75 are slidably engaged in the bores of these screws. In Fig. 4, the work-engaging peripheries of the rolls F, F are shown knurled to give them a better hold on the work W.

The feed rolls F, F are driven from the shaft S through the gearing G, shaft 55, and its gear 57, which meshes with a gear 78 connected to the shaft 70 of the lower roll F. As shown in Fig. 4, the gear 78 is secured and keyed fast on a hollow shaft 79 that is journaled in a bearing bracket 80 on the casing and bracket structure E. A sleeve 81 engaged around the end of the shaft 70 and keyed thereto is anti-turnedly engaged in the hollow shaft 79, though free for longitudinal movement relative thereto. This permits transverse adjustment of the feed rolls F, F with the base plate 67 relative to the bracket 65 to bring various portions of the roll surfaces into engagement with the work W, so that the rolls shall wear more evenly.

The gearing G (Fig. 1) is lubricated by revolution of gear 54 in oil in the bottom of the gear chamber 50, and the bearing B2 is splash-lubricated by this gear 54. The oil that works through the bearing B2 into the left-hand end of the chamber 47 runs back into the bottom of the gear chamber 50 through a sloping duct 82. The bearing B1 runs in oil in the bottom of the chamber 35, below the shaft S. The oil may be supplied to chamber 35 from above, when needed from time to time, through an upright duct 83 extending down to a longitudinal duct 84 in the upper wall of the chamber, above the outer race-way of the bearing B1. The swaging die mechanism D may be lubricated by oil supplied from above through an upright duct 85 whose lower end opens into a duct 86 which extends rearward and then downward in the outer and rear surfaces of the liner 11. From the lower end of the duct 86, the oil passes forward inside the liner 11 to the upper roller pockets of the cage 21. From the rollers 20, the oil works into the guideway in the head 14, thus lubricating the movement of the actuating blocks 12 and die-blocks 13 in said guideway. From the lower rollers 20, the oil passes to the rear past the outer periphery of the cage 21 into a pocket 87 formed by a notch in the washer 10, whence it drains away through a

downward-sloping duct 88. Some of the oil from the swaging dies may also escape forward through the opening of the guide plug 26. The lubricant escaping in this manner, as well as that draining away through the duct 88, flushes away dirt, scale, and other waste matter from the die mechanism.

The plate or septum 37 between the die mechanism recess or chamber 9 and the bearing and lubricating chamber 35 prevents or minimizes contamination of the bearing lubricant with dirty lubricant from the die blocks 13 and the work W, and also prevents lubricant from the chamber 35 from escaping into the die mechanism recess 9.

Heat absorbed by the guide plug 26, the die mechanism D, and the shaft S from the work W is transmitted to the cover 25 and the heads H1, H2, and is removed by cooling the latter, as well as any heat absorbed from the motor M. For this purpose, cooling fluid (preferably water) is circulated through the cover and head structures. As shown in Figs. 1 and 3, the cover 25 is circularly hollowed at 90 nearly all the way around the guide plug 26, and circulating ducts 91, 92 extend from the upper and lower inlet and outlet nipples 27, 28 to the ends of the circular passage 90. The main body of the head H1 is also circularly hollowed, having a cooling duct 93 extending (in proximity to the motor space) from an inlet pipe 94 at the bottom of the head up around the die mechanism D and the bearing B1 and down again to an outlet pipe 95 adjacent the pipe 94. For cooling the head H2, its gear casing structure E is circularly hollowed, with a cooling duct 96 extending from a lower inlet pipe connection 97 up over and around the gear chamber 50 to a lateral outlet pipe connection 98 at the other side of the gear chamber. As indicated by the reference numerals in Figs. 3 and 4, the water may preferably traverse the passages in cover 25, head H1, and gear casing structure E in succession: i. e., the hose 100 connects the outlet pipe 28 of the cover 25 with the inlet pipe 94 of the head H1, and the hose 101 connects the outlet pipe 95 of the head H1 with the inlet pipe 97 of the structure E.

As shown in Figs. 1, 3, and 4, the heads H1 and H2 are provided with feet 102 for securing the swager to a suitable support or bed by means of bolts 103, for example.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a swaging machine, the combination of interconnected spaced heads, including a swaging head provided with swaging-die mechanism; a hollow shaft actuating said mechanism in the swaging head, and extending through and projecting beyond the other head; a motor between said heads, with a rotor on the shaft for driving it; a gear case and bracket structure mounted on and behind said other head, around the projecting shaft end, with gearing driven by the latter in the gear case; and feed rolls behind the gear case, for drawing the work through said heads and shaft, mounted on said gear case and bracket structure, and driven by said gearing.

2. In a swaging machine for hot metal, the combination of a frame structure including a swaging head provided with swaging-die mechanism, of a hollow actuating shaft for said mechanism journaled in said structure, and a heat-insulating bushing in said shaft affording passage therethrough for the work and minimizing heating of the shaft from the work.

3. In rotary swaging-die mechanism, the com-

bination with a revolving member affording axial passage for work therethrough and provided with radially extending guideways, of die and actuating blocks movable in said guideways to act on the work passing through said member, and facing strips of resilient wear-resistant sheet

metal interposed between said blocks and the guideway faces, and having bent ends engaged over corresponding shoulders of said member to hold the facing strips in place.

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