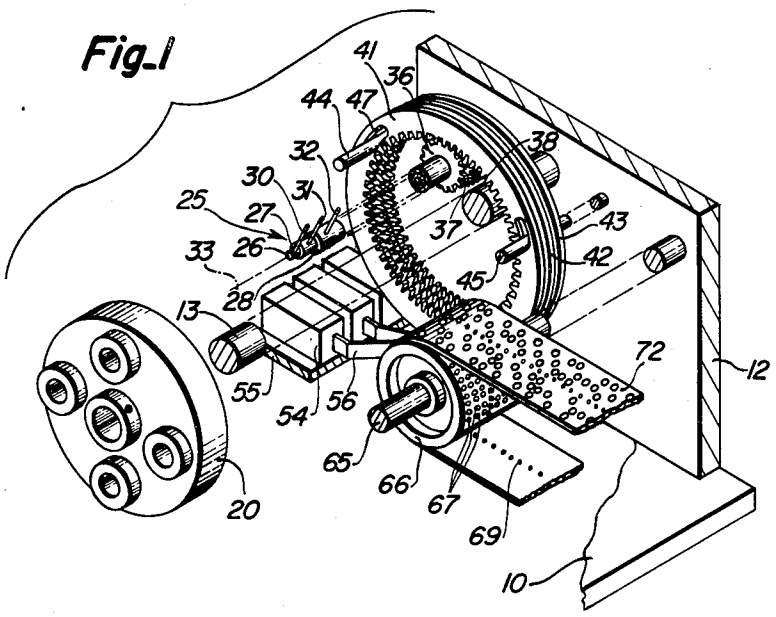
July 26, 1960 A. W. SCRIBNER 2,946,380

HIGH SPEED PUNCH

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Fig_1



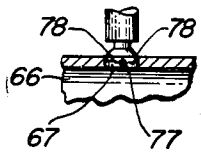


Fig_3

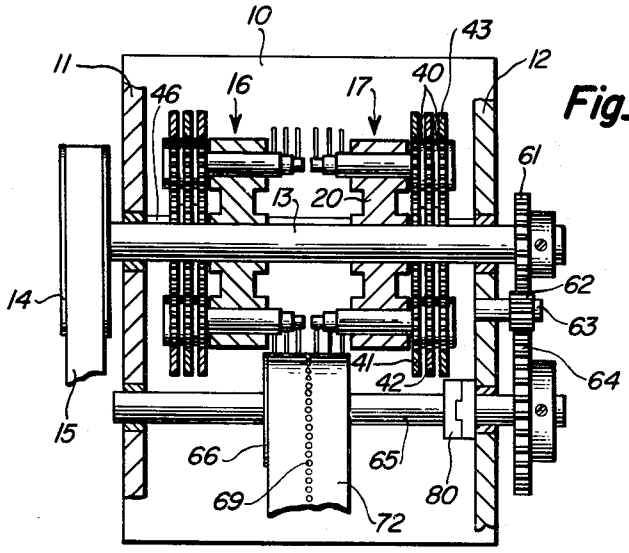


Fig_2

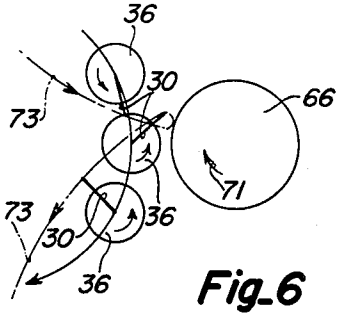


Fig_6

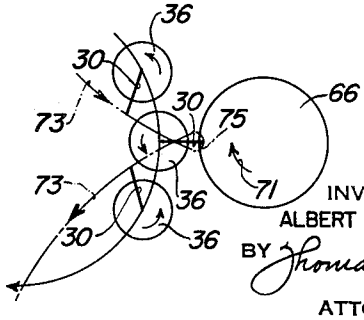


Fig_7

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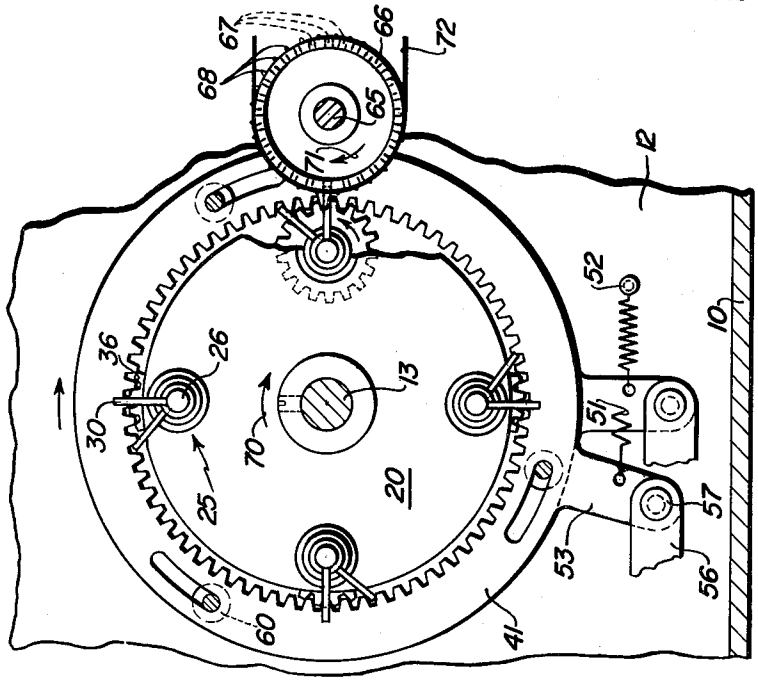


Fig. 5

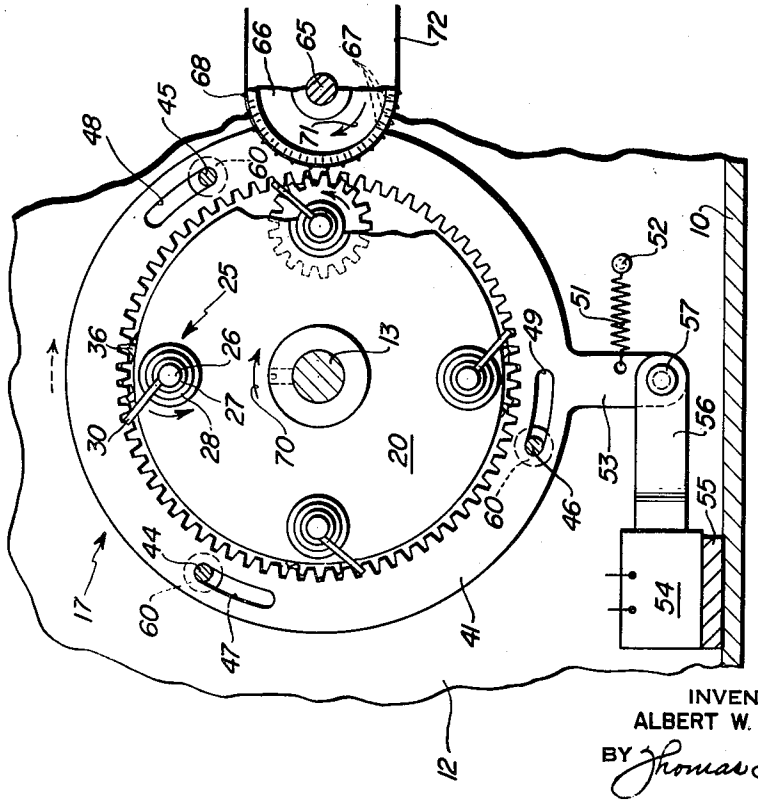


Fig. 4

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HIGH SPEED PUNCH

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12 Claims. (Cl. 164—111)

This invention relates to a high speed punch and more particularly relates to a novel "flying" punch which is capable of rapidly perforating a record tape or card.

In conventional types of record punches the various individual punch elements are usually selectively actuated by being coupled and uncoupled from a power driven means. Here the axial reciprocation and/or swinging motion of the punch elements occurs only when a perforation in the record is to be made; said elements otherwise occupying a normal rest position. The high speed serial starting and stopping of the punch elements, and the related parts of the intermittently operated tape feed drive means, gives rise to a considerable amount of vibration which in turn limits the maximum speed and operational efficiency of the record punch apparatus. The several types of "flying" punches which have been previously proposed possess either the above noted operational difficulties, or have a further disadvantage resulting from the punch elements following various non-circular type paths. In the latter case the continual abrupt changing of the rectilinear type translational motion of the punch elements causes vibrations to be set up during the high speed operation of the machine. Thus this type of non-circular translational motion of the "flying" punch elements further limits the speed, efficiency and/or effective life of the punch system and will establish various design requisites such as minimum size and strength permissible for many of the machine parts.

One object of the instant invention is to provide a novel record punch for more rapidly and efficiently perforating a record tape or card.

Another object of the invention is to provide an improved record punch whereby a record may be successively and efficiently perforated by means of a plurality of "flying" punch elements and at speeds far greater than that possible in conventional types of such record punches.

Another object of the invention is to provide a novel "flying" punch in which the operational selectivity of the various individual punching elements is obtained by respectively altering the individual phase of motion of said elements.

A further object of the invention is to provide a novel "flying" punch having a plurality of planetating punch elements whose respective individual motion phases may be selectively changed whereby a serial tape punching operation may be effected without the necessity of interrupting the feed motion of the tape.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which like reference numerals designate like parts throughout the figures thereof and wherein:

Fig. 1 is an exploded perspective view illustrating the structural and operational characteristics of the instant invention.

Fig. 2 is a plan view in partial section taken in the horizontal plane of two main shafts of the instant punch apparatus.

Fig. 3 is a partial sectional elevational view and shows the guide means mounted on the operative ends of the respective punch elements.

Figs. 4 and 5 are sectional elevational views respectively showing the normal and active position of the motion phase change gearing for one set of the punch elements of the instant apparatus.

Figs. 6 and 7 are diagrammatic views illustrating the mode of operation of the instant punch apparatus.

Referring to Figs. 1 and 2 the instant apparatus comprises a frame having a base **10** on which is fixedly secured two parallel side members **11** and **12**. Rotatably mounted in said side frame members is a main shaft **13** to the left end of which is rotatably secured a pulley **14** that is adapted to be power driven by a belt **15**. A pair of punch supporting heads **16**, **17** are rotatably secured to said shaft. In that the structural and operational nature of each head is the same a detailed discussion of one thereof will suffice here. The punch supporting head **17** comprises a member **20** which rotatably supports a plurality of groups of telescopically mounted shafts; the common axes of said groups being respectively equidistant from the axis of the shaft **13**. In that the structural and operational nature of each of said groups is the same only one thereof will be discussed in detail here. Referring to Figures 1, 2, 4 and 5, the group **25**, Fig. 4, comprises three telescopically mounted shafts **26**, **27** and **28**; shaft **26** being rotatably mounted in the tubular shaft **27**, shaft **27** being rotatably mounted in tubular shaft **28**, and shaft **28** being rotatably supported by said member **20**. Punch elements **30**, **31** and **32** are fixedly secured to the inner or left ends, Fig. 1, of shafts **26**, **27** and **28** respectively; the outer operative ends of said elements extending through equal radial distances from the common axis **33**, Fig. 1, of said shaft group **25**. Rotatably secured to the outer ends of said shafts **26–28** are planetary gears **36**, **37** and **38** respectively; said gears being maintained in predetermined axial spaced relation by means of spacing washers such as **40**, Fig. 2.

Said gears **36–38**, as well as the corresponding gears for the other groups of telescopically mounted shafts on head **17**, are adapted to respectively mesh with the internal ring gears **41**, **42** and **43** which are coaxially disposed with respect to the shaft **13**. Said ring gears are mounted on the machine frame by means of a plurality of fixed transverse supporting shafts **44**, **45** and **46**, Figs. 1 and 4, which are fixed to the side members **11**, **12** of the machine frame. In that the means for mounting and actuating each of said ring gears **41–43** are similar, explanation of such for one ring gear (**41**) will suffice here. Said transverse shafts **44–46** respectively extend through and slidably engage the walls of arcuate slots **47**, **48** and **49**, Fig. 4, formed in ring gear **41**; the center of curvature for each of said slots being located at the axis of said shaft **13**. It will be apparent that ring gear **41** may be rotated to predetermined clockwise and counter clockwise positions defined by the engagement of said shafts **44–46** with the respective ends of the arcuate slots **47–49**.

Ring gear **41** is normally maintained in the counter clockwise position shown in Fig. 4 by means of a spring **51** which is secured between the fixed cross shaft **52**, mounted in the machine side member **12**, and a depending extension **53** formed on the lower portion of said ring gear. The means for actuating gear **41** comprises a solenoid **54**, Fig. 4, which is fixedly supported on the cross member **55** secured to the said side members **11**,

12 of the machine frame. The armature 56 of said solenoid is articulately connected, as at 57, to the said depending ring gear extension 53. Energization of solenoid 54 will serve to rotatably shift ring gear 41 to its clockwise position shown in Fig. 5, against the action of spring 51. Deenergizing said solenoid will permit spring 51 to return gear 41 to its said normal counter clockwise position, Fig. 4. The three ring gears 41–43 are maintained in fixed axial spaced relation by means of spacers 60, Fig. 4, fixed to said shafts 44–46.

Rotatably secured to the outer or right hand end of shaft 13, Fig. 2, is a gear 61 which meshes with an idler gear 62 that is rotatably mounted on the side member 12 by means of the stub shaft 63. Gear 62 also meshes with a gear 64 fixed to the outer end of a shaft 65 that is rotatably mounted in said side members 11 and 12. Rotatably secured to shaft 65 is a record feeding and supporting drum 66 which has a plurality of aligned and longitudinally extending rows of six holes or bores 67, Fig. 1, formed through the walls of the tubular portion thereof. The circumferential as well as the longitudinal spacing between said bores is uniform and corresponds to that desired for the perforations in the record tape or card. Said drum is also provided with a plurality of peripherally spaced teeth 68, Figs. 4, 5, which successively engage the usual feed holes 69, Fig. 2, of the record. Each group of six related punch elements is adapted to selectively cooperate with the six bores 67 in one of said rows of holes in said drum 66, Fig. 1, so as to selectively perforate the record in a manner which will be subsequently described in detail in connection with Figs. 6 and 7. It will be understood that the various groups of telescopically mounted shafts in the punch supporting head 16 are always axially aligned with and are normally in phase with the corresponding groups of shafts in the head 17.

Turning now to a consideration of the operational nature of the instant apparatus particular reference will be made to Figs. 4–7. In that each punch element operates in a similar manner, a consideration of one thereof (30) will suffice here. Referring to Fig. 4, it will be seen that as the member 20 is driven in a clockwise direction 70 by means of the constantly rotating shaft 13, the gear 36 will planetate in timed relation thereto around the inside of the stationary ring gear 41 and will thereby cause punch element 30 to partake of a corresponding planetary type motion. At the same time the tape feed drum 66 will be rotated in a clockwise direction 71 and in timed relation to the rotation of shaft 13 through said gears 61, 62, 64 thereby continually feeding the record tape 72 past the various planetating punch elements. Here, in that the distance between the axis 33 of the punch supporting shaft 26 and the outer operative end of punch element 30 is greater than the radius of the pitch circle of the associated gear 36, the trajectory or path of motion of the said outer end of said punch element 30 will define a modified type of hypocycloid as illustrated at 73 in Fig. 6. This type of path will be hereinafter referred to as being defined by a prolate hypocycloidal curve. It will be noted from Fig. 6 that the rotative or phase position of curve 73 is such that the outer end of punch element 30 always "misses," and hence can never cooperate with, the bores formed in said tape feed drum 66. As long as ring gear 41 remains in its normal counterclockwise position of Fig. 4 the punch element 30 will not enter any of the bores 67 in the rotating drum 66 and the continually moving record tape 72 will not be perforated.

When it is desired to have said punch element 30 enter one of said bores 67 and thereby perforate the record the solenoid 54 is energized so that ring gear 41 is shifted to its clockwise position as shown in Fig. 5. This rotative shifting of ring gear 41 will alter the motion phase of both the gear 36 and the punch element 30 thereby shifting the phase or rotative position of the prolate hypocycloidal curve 73 to a clockwise orientation as illustrated in Fig. 7. Here as the outer end of punch element 30 passes through the outermost portion 75 of the shifted curve or path 73 it will be moving in a general counterclockwise direction and will be in a position to cooperate with one of the bores 67 of the drum 66 which is moving in said clockwise direction 71 in timed relation to the motion of said punch element 30. This action will cause the moving record tape 72 to be perforated by the operative end of said punch element 30. For a given size for each of the other parts shown, the effective radial length of the punch element 30 relative to the radius of the pitch circle of gear 36 is adjusted so that during the punching action described in connection with Figs. 5 and 7, the outer operative end of said punch element and the associated bore 67 are progressively and mutually engaged in a manner similar to that of the teeth of two meshing gears. The speed ratio between shafts 65 and 13 will be equal to the circumferential pitch ratio of the bores 67 and the groups, such as 25, of telescopically mounted shafts in the member 20.

Deenergizing the solenoid 54 will permit spring 51 to return the ring gear 41 to its normal Fig. 4 position thereby restoring the phase of the curve 73 to its ineffective or counterclockwise position as shown and described in connection with Figs. 4 and 6.

It will be seen that the various flying punches of the instant apparatus partake of a continual planetary motion and that the punching or no-punching operation of each punch element will be selectively determined by individual phase condition of the planetary motion of each of said elements. Thus by serially energizing various combinations of the six solenoids of the instant apparatus in accordance with a particular six level code, the successive codes will serially appear as coded perforations in the continuously moving record tape 72. The punch heads 16 and 17 may be continuously rotated at very high speeds thereby permitting the selective punching of the record tape at correspondingly high speeds. This action is accompanied by a minimum amount of vibration in that none of the principal moving parts of the machine are reciprocated. These factors make the instant apparatus highly desirable for use with high speed data processing equipment.

In order to insure that the various flying punch elements register with and properly engage the various bores 67 during the punching operation illustrated in Fig. 7, the outer end of each of said elements is provided with a plurality of radially extending blades 77, Fig. 3, which have tapered shoulders 78 that are adapted to slidably engage the walls of said bores 67 and which thereby serve to radially guide the cutting edges of each punch element into proper alignment and cooperative engagement with its associated bore 67.

If desired a suitable clutch 80 may be provided in connection with shaft 65 so that the drum 66 may be stopped where no perforating operations are to take place for a considerable length of time. If the effective lengths of the various punch elements are made equal to the radii of the pitch circles of the respectively associated planetary gears then the motion of the outer ends of said punch elements will move through a regular type of hypocycloidal path and here the drum shaft 65 may then be intermittently rotated from shaft 13 by the drive means illustrated in Figs. 6–8 of the commonly owned copending application of Harry L. Lambert, Serial No. 642,764, filed February 27, 1957, for "Perforated Record Reader and Feed Mechanism," now Patent Number 2,900,130.

While several embodiments of the invention have been shown and described, it will be apparent to those skilled in the art that numerous variations and modifications may be made in the particular construction without departing from the underlying principles of the invention. It is therefore desired, by the following claims, to include within the scope of the invention all such variations and

modifications whereby substantially the results of the invention may be obtained by the use of substantially the same or equivalent means.

The invention claimed is:

1. In a record punch; a frame, a record feeding and supporting means, at least one punch supporting member rotatably mounted in said frame, a plurality of punch elements spaced and rotatably supported about the periphery of said member and adapted to selectively cooperate with bores formed in the periphery of said record supporting means, a planetary gear connected to each of said punch elements, a plurality of ring gears shiftably mounted in said frame, said ring gears respectively cooperating with said planetary gears, and means for selectively rotatably indexing said ring gears.

2. Apparatus as defined by claim 1; additionally comprising, means for rotatably driving said member, and means for rotatably driving said record feeding and supporting means in timed relation to the rotation of said member.

3. Apparatus as defined by claim 2 wherein the operative ends of said punch elements are provided with substantially radially disposed blade type guide means which are adapted to insure correct alignment of said punch elements as the latter moves into operative engagement with said record supporting and feeding means.

4. Apparatus as defined by claim 3 wherein the effective radial lengths of said punch elements are greater than radius of the pitch circle of the respectively associated planetary gears.

5. A record punch; comprising a frame, a record supporting and feeding means rotatably mounted on said frame, at least one punch supporting member rotatably mounted in said frame, a plurality of punch elements rotatably supported and equally spaced about the periphery of said member, a planetary gear connected to each of said punch elements, a plurality of internal ring gears shiftably mounted in said frame and respectively meshing with said planetary gears, individual means for selectively rotatably shifting each of said ring gears to one of two operative positions, and means for rotating said record supporting and feeding means in timed relation to the rotation of said member.

6. Apparatus as defined by claim 5 wherein said record supporting and feeding means comprises a drum having a plurality of spaced bores formed in the walls of the tubular portion thereof, said punch elements being selectively cooperable with said bores.

7. Apparatus as defined in claim 6 wherein the effective lengths of said punch elements are greater than the radii of the pitch circles of the planetary gears respectively associated with said elements.

8. Apparatus as defined by claim 6 wherein the effective lengths of said punch elements are equal to the radii of the pitch circles of the planetary gears respectively associated with said elements.

9. A record punch; comprising a frame, at least one punch supporting member rotatably mounted on said frame, power operated means for driving said member, a plurality of groups of shafts rotatably mounted at the periphery of said member, each group of said shafts being mutually telescopically disposed, a punch element and a planetary gear fixed to each of said shafts, a plurality of rotatably shiftable ring gears mounted in said frame and adapted to mesh with said planetating gears, means for individually shifting said ring gears, a record supporting drum rotatably mounted in said frame and having a plurality of bores formed therein which are selectively cooperable with said punch elements, and means for rotating said drum in timed relation to the rotation of said punch supporting member.

10. A record perforating device; comprising a frame, a record feeding and supporting drum rotatably mounted on said frame, the periphery on said drum being formed with a plurality of die holes disposed in a predetermined pattern of distribution, a punch supporting member rotatably mounted on said frame, at least one group of telescopically disposed shafts each rotatably mounted on said punch supporting member, a radially extending punch element secured to the inner end of each of said shafts, the outer ends of said elements being adapted to shearingly cooperate with different ones of the die holes formed in said drum, a planetary gear secured to each of said telescopically mounted shafts, a plurality of gear means operative to respectively cause said planetary gears to rotate when said punch supporting member is rotated, selectively operable means for respectively shifting said gear means between normal and displaced positions, the path of movement of each punch element being conditioned to cooperate with one of said holes in said drum when the related gear means is moved to its displaced position and being conditioned to avoid cooperation with said one hole when the related gear means is moved to its normal position, and drive means for rotating said record supporting drum and said punch supporting member in timed relation.

11. Apparatus as defined by claim 10 wherein the effective radial length of each punch element is greater than the radius of the pitch circle of the associated planetary gear.

12. Apparatus as defined by claim 10 wherein the effective radial length of each punch element is substantially the same as the radius of the pitch circle of the associated planetary gear.

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