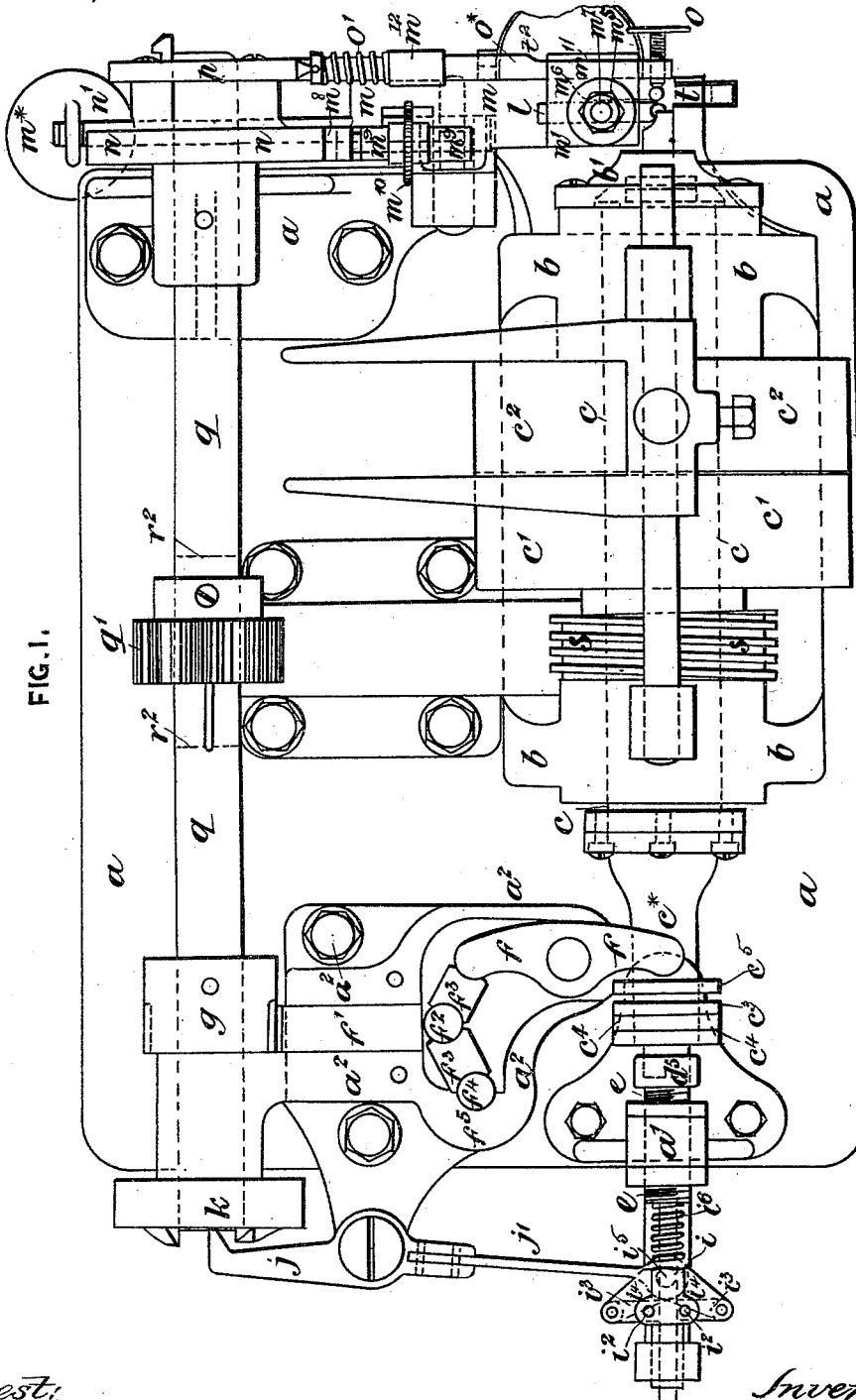


G. TAYLOR.

APPARATUS FOR MANUFACTURING METAL BALLS.

No. 491,452.

Patented Feb. 7, 1893.



Attest:
George E. Crane
Harry D. Colver

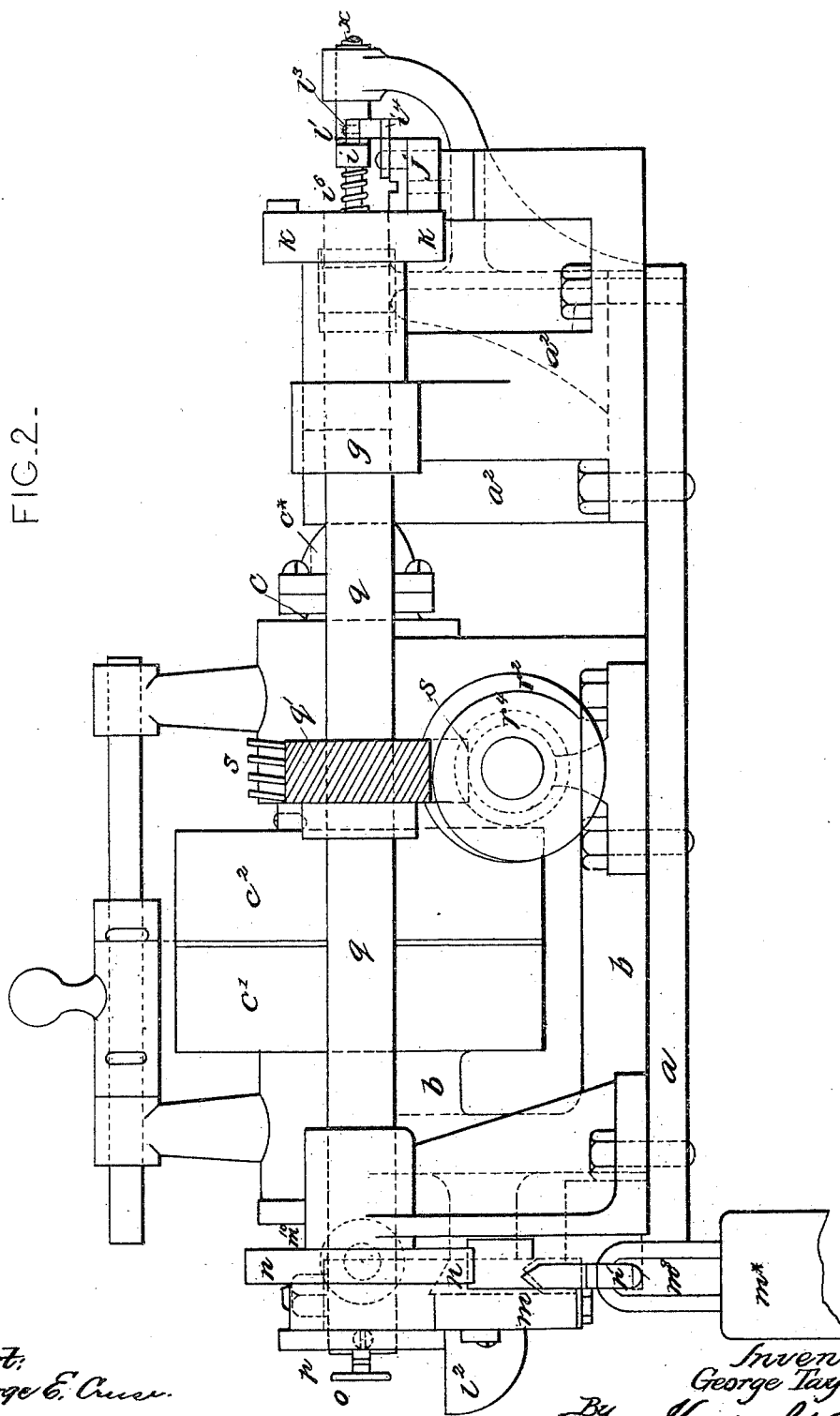
Inventor:
George Taylor
By Knight Bros.
Attorneys

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Attest:
George E. Cress.
Harry S. Rohrer.

Inventor:
George Taylor
By Knight Bros.
Attorneys.

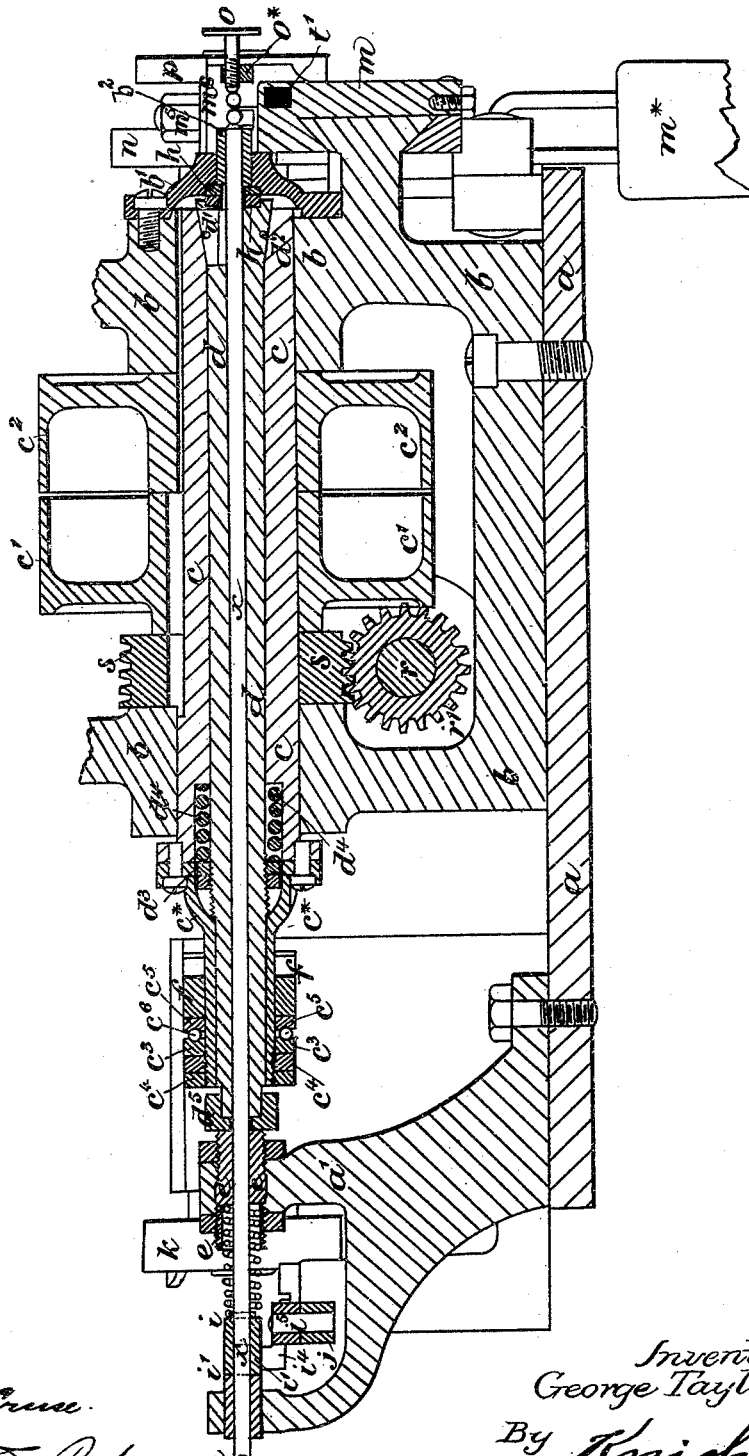
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FIG. 3.



Attest:
George E. Crane.
Harry D. Roberts.

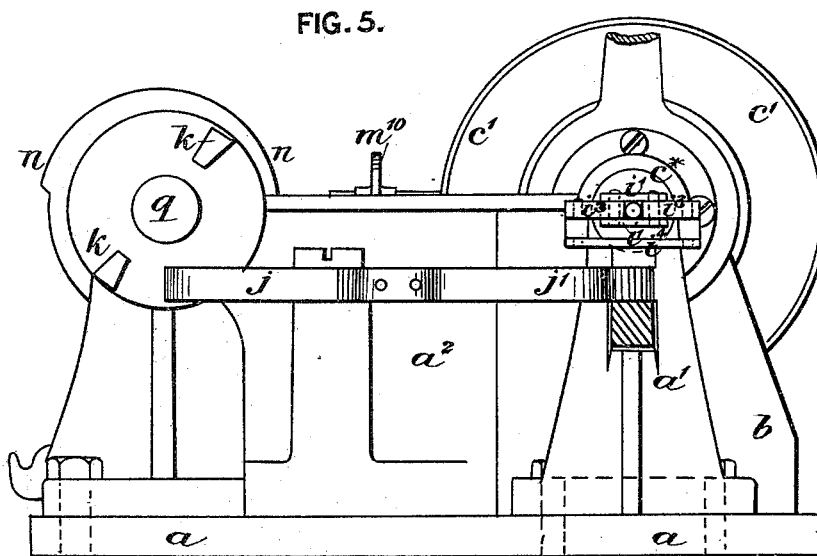
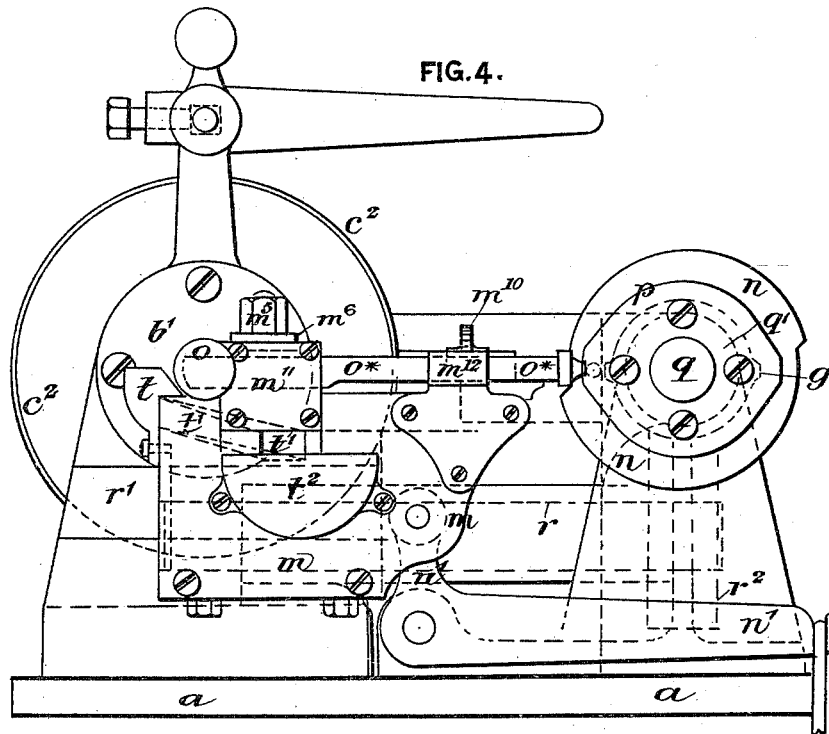
Inventor:
George Taylor.
By Knight Bros.
Attorneys.

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Attest:
George E. Cruse.
Harry D. Robinson

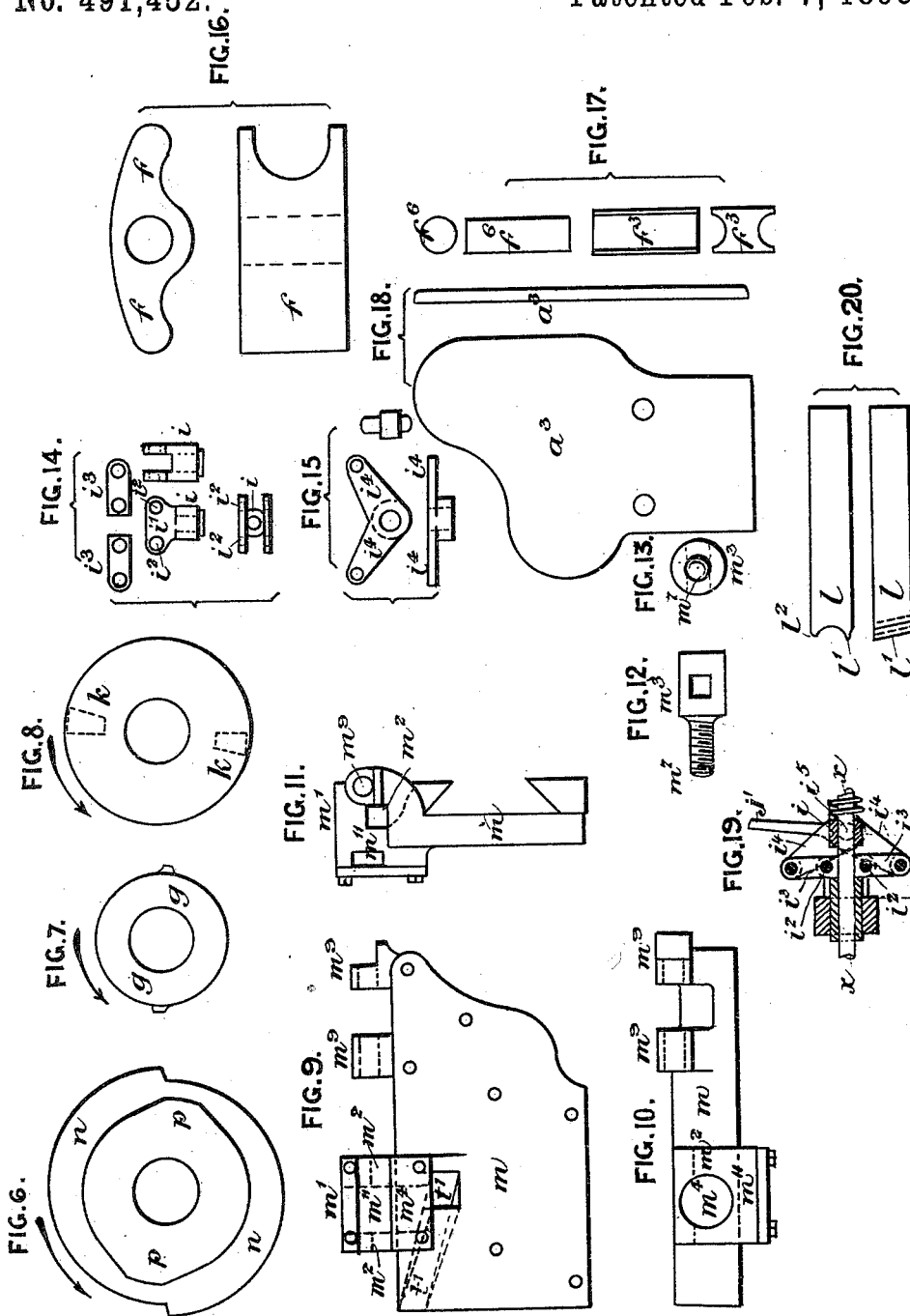
Inventor
George Taylor
By Knight Bros.
Attorneys

G. TAYLOR.

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Attest:
George E. Chase.

Wm. J. Rohrer

Inventor:
George Taylor.

By Knight Bros.
Attorneys.

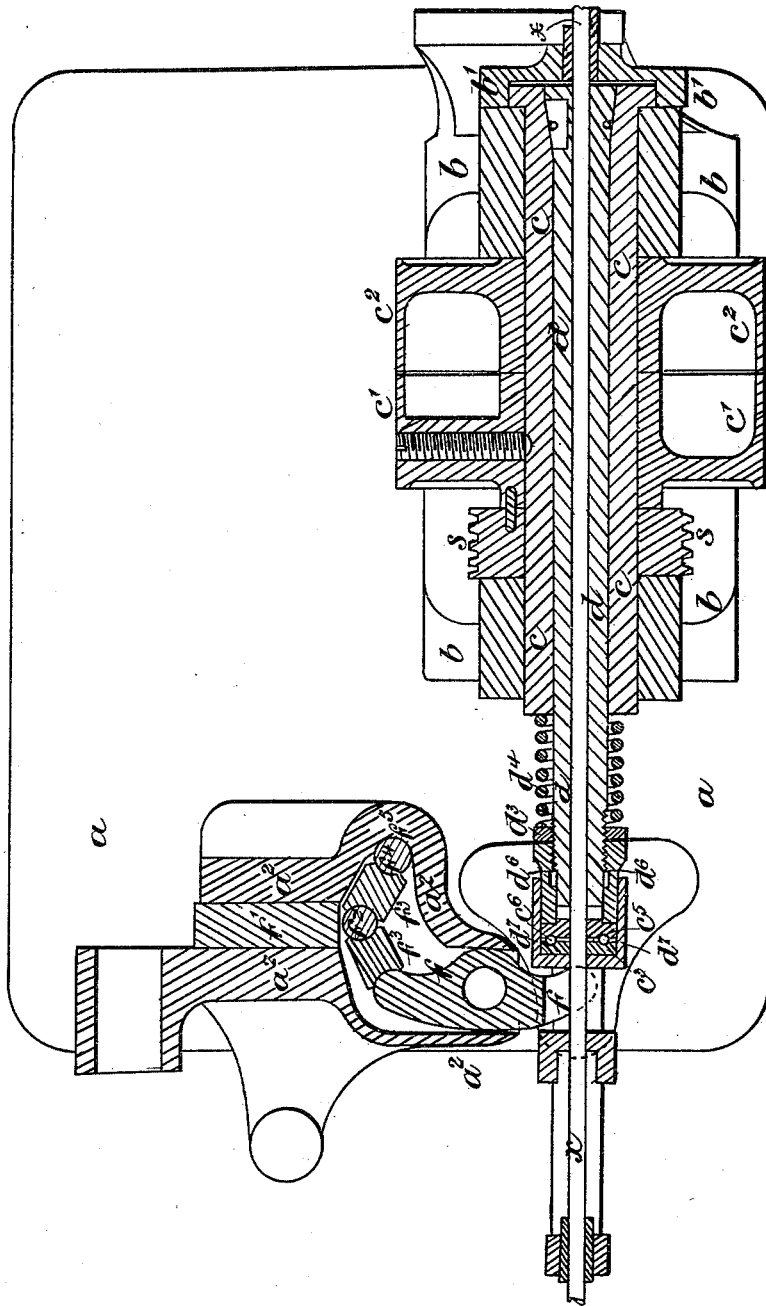
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FIG. 21.



Attest:
George E. Cause
Harry D. Rohrer.

Inventor:
George Taylor
By Knight & Bros.
Attorneys.

UNITED STATES PATENT OFFICE.

GEORGE TAYLOR, OF COVENTRY, ENGLAND, ASSIGNOR TO TAYLOR, COOPER & BEDNELL, LIMITED, OF SAME PLACE.

APPARATUS FOR MANUFACTURING METAL BALLS.

SPECIFICATION forming part of Letters Patent No. 491,452, dated February 7, 1893.

Application filed October 22, 1891. Serial No. 409,568. (No model.)

To all whom it may concern:

Be it known that I, GEORGE TAYLOR, managing director of Taylor, Cooper & Bednell, Limited, a subject of the Queen of Great Britain, residing at Raglan Works, Coventry, in the county of Warwick, England, have invented certain new and useful Improvements in Machinery to be Employed in the Manufacture of Metal Balls or Spheres, of which the following is a specification.

The invention has for its object a novel arrangement or combination of parts whereby a metal rod is fed forward through a hollow spindle against a stop, and is securely held and rotated while a turning tool or cutter shapes a ball or sphere, and is released at the required time to permit of a fresh feed thereto, the cutter being gradually moved forward by a cam when acting on the metal, and being withdrawn therefrom by a weight or spring on the completion of the turning of a ball or sphere.

In carrying my invention into effect I employ a hollow driving spindle mounted in a head-stock and provided with fast and loose pulleys to receive a driving strap, by which the said hollow driving spindle can be rotated. Through this hollow driving spindle is passed another hollow spindle, whose front end carries a coned chuck fitted with three outwardly sprung gripping dogs, and the rear end of such hollow chuck spindle has a thrust collar, against which a spring is caused to bear to force the said chuck spindle normally backward. The front end of the hollow driving spindle is coned to receive the chuck, so that when the latter is forced backward by the aforesaid spring, the dogs are forced toward the center of the chuck to grip the metal rod used in the formation of the balls or spheres. The said metal rod is passed through the hollow chuck spindle and is gripped at the required times by the chuck dogs to rotate the same, and is released by said chuck at the time required to feed the same forward.

The hollow chuck spindle has a cap at its rear end, which is provided with bearing balls between it and the rear end of the chuck spindle to reduce friction, and such cap is acted upon by a lever operated by a cam to

move the said chuck spindle forward when it is required to release the metal rod from the chuck. This feeding of the metal rod is effected by means of a friction clutch or grip, through which it is loosely passed; the body of such clutch or grip is acted upon by a spring to retain it normally at its rear position; the gripping levers or jaws are mounted on pin-joints in the said body, and they are also pin-jointed to a bar which is hinged or pin-jointed to one end of a lever, whose other end is acted upon by a cam to force the friction clutch or grip, and consequently the metal rod, forward, after the completion of each ball or sphere.

I employ a single cutter for the purpose of turning and cutting off the balls from the metal rod, and such cutter is made with a concave cutting edge or profile of almost an exact semi-circle in shape, the front angle or corner of which is carried fully up to, or slightly beyond, the center of the ball, while the rear angle or corner is slightly short of such center; such cutter is mounted in a slide, which is pressed forward toward the metal rod by a cam, and is drawn backward by a weight or spring, which keeps it firmly against the cam. The cams are mounted on a shaft which is parallel with the hollow driving spindle, and receives motion therefrom preferably by a cross shaft and screw gear.

The action of the machine is as follows:—The metal rod is passed through the hollow chuck spindle until its front end is against the stop herein referred to; it is then gripped by the chuck, by which it receives rotary motion; the cutter is gradually advanced against the projecting front end of the rod, until a ball or sphere is almost completely formed; it then retires, the rod is again advanced the length required for making another ball or sphere, when the cutter is again advanced and, in turning another ball or sphere, the front angle or corner of the cutter severs the previously turned ball or sphere from the rod; if desired the said front angle or corner of the cutter may be hollowed on its front or outer side, so as to conform more completely to the shape required to complete the spherical form of the ball or sphere being cut off.

Balls or spheres made as above described are afterward finished by "lapping," as is well understood.

I would here remark that in lieu of making the hollow driving spindle a fixture endwise and giving endwise motion to the hollow chuck spindle, I prefer to make the chuck spindle a fixture endwise and to move the driving spindle, the parts connected therewith being suitably modified, as will be hereinafter described.

In order that my said invention may be more clearly understood and readily carried into effect, I will proceed aided by the accompanying drawings, more fully to describe the same.

In the drawings Figure 1 is a plan, Fig. 2 is a right side elevation, Fig. 3 is a left side section, Fig. 4 is a front elevation, and Fig. 5 is a back elevation, of a metal ball turning machine constructed according to my invention. Figs. 6, 7 and 8 show the various cams. Figs. 9, 10 and 11 are respectively a front, plan, and end view of the tool carrying slide. Figs. 12 and 13 are respectively a plan and elevation of the tool holder. Figs. 14 and 15 are various views representing details of feeder. Figs. 16 are a plan and side elevation of releasing bar. Figs. 17 are views of various parts of the releasing bar connections, and Figs. 18 are a plan and edge view of cover for the releasing bar and its connections. Fig. 19 is a sectional plan representing the feeder separately. Figs. 20 are a plan and side view of the cutter separately, and Fig. 21 is a sectional plan of parts of a ball making machine showing modifications.

In all the figures like parts are indicated by similar letters of reference.

I will first describe the arrangement represented at Figs. 1 to 20.

a is the lathe bed, *b* is the head-stock fixed to the said bed.

c is a hollow driving spindle mounted in the head-stock and provided with fast and loose pulleys, *c'*, *c''*, to receive a driving strap, by which the hollow spindle *c* can be rotated. The fast or driving pulley *c'* has a key fixed in its boss, and a key way is formed in the hollow driving spindle *c*. Through this hollow spindle *c* is passed another hollow spindle *d*, whose front end carries a coned chuck fitted with three gripping dogs *d'*, which are sprung outward by means of a light annular spring *d''*, while near the rear end of such hollow chuck spindle *d*, a thrust collar *d'''* is screwed thereon, against which a spring *d''''*, inclosed in an annular space formed in the rear end of the hollow driving spindle *c*, is caused to bear, to force the said hollow driving spindle normally forward. The front end of the hollow driving spindle *c* is coned out to receive the chuck, so that when the hollow driving spindle *c* is forced forward by the said spring *d''''*, the dogs *d'* are forced toward the center of the chuck to grip the metal rod *x* used in the formation of the balls or spheres. The metal

rod *x* is passed through the hollow chuck spindle *d*, and is gripped at the required times by the chuck dogs *d'*, to rotate the same, and is released by said chuck at the required time to feed the same forward.

The hollow chuck spindle *d* has a cap *d''* at its rear end, which bears against a hollow adjustable tail pin *e* fixed in the standard *a'*, and an attached continuation *c''* of the hollow driving spindle *c* has a steel collar *c''* at its rear end held in position by screw collars *c'''*, and between such collar *c''* and another loose steel collar *c''''* thereon, acted upon by a lever *f* as hereinafter described, bearing balls *c'''''* are placed to reduce friction. The loose collar *c''''* is acted upon by the lever *f* in the following manner to move the hollow driving spindle *c* backward when it is required to release the metal rod *x* from the chuck. A cam *g* acts upon one end of a slide *f''*, the other end of which bears against a pin *f'''* placed between a pair of toggle links *f''''*, one of which bears against a pin *f'''''* located in a fixed bearing *f''''''*, the other bears against one end of the lever *f*, which is mounted on the axis *f'''''''*, and bears at its other end against the said loose collar *c''''*. The parts *f* to *f'''''''* are fitted within a standard or frame *a''* and a cover *a'''* is employed to cover in such parts.

The hollow chuck spindle *d* bears at its front end against a loose steel stop, collar, or disk *h*, between which and the tail pin *e*, the said chuck spindle *d* is securely held endwise. Such loose steel stop or collar *h* bears against a similar loose collar, and these are held in position by a cap or cover *b'* screwed to the front of the head-stock *b*, and such cap or cover is fitted with a bush or steady *b''*, through which the rod *x* passes, and by which it is supported close up to the cutter *l*.

The feeding of the metal rod *x* is effected by means of a friction clutch or grip, through which it is loosely passed, and which is constructed and operated in the following manner. *i* is the body of the clutch or grip, which is bored so as to permit of the free passage of the metal rod *x* therethrough, and it is formed with cheeks *i'* located above and below the rod *x*, and having vertically perforated ears *i''* at each side of the rod *x* to enable the gripping levers or jaws *i'''* to be hinged or pin-jointed thereto at their inner ends, and such gripping levers or jaws *i'''* are also pin-jointed at their outer ends to the outer ends of a bar *i''''*, which is hinged or pin-jointed at *i'''''* to one end of a feed lever *j*, whose other end is acted upon by a cam *k* to force the friction clutch or grip, and consequently the metal rod *x*, forward, after the completion of each ball or sphere. A spring *i''''''*, the forward end of which is located in a recess in the rear end of the tail pin *e*, acts against the clutch body *i* to retain the clutch normally at its rear position. The feed lever *j* is formed with a spring fore end *j'*, and the feed cam *k* is arranged to feed a longer length of rod *x* than is required for a ball, but when the rod *x* comes against the

stop *o* hereinafter described, said spring fore end *f'* will give way and thereby avoid marking or injuring the rod *x*.

I employ a single cutter *l* for the purpose of turning and cutting off the balls from the metal rod *x*, and such cutter *l* is made with a concave cutting edge or profile of almost an exact semi-circle in shape, curved upon an axis extending at right angles to the axis of rotation of the machine, the front angle or corner *l'* of which is carried fully up to, or slightly beyond, the center of the ball, while the rear angle or corner *l''* is slightly short of such center; such cutter *l* is mounted in a square horizontal hole *m*² formed in the projection *m'* on the slide *m*, and it is secured firmly in position by being passed through a tool holder *m*³ fitted in a hole *m*⁴ in the projection *m'*, a nut *m*⁵ and a large washer *m*⁶ passed over the screw pin *m*⁷, being employed to draw up the tool holder *m*³ and thereby fix the cutter *l* firmly in position by binding it against the upper side of the hole *m*². The slide *m* is pressed forward toward the metal rod *x* by a cam *n*, and is drawn backward by a weight *m*^{*}, or it may be a spring acting upon the outer end of the horizontal arm of a crank lever *n'* connected with the slide, which keeps it firmly against the cam *n*. In order that the slide *m*, and consequently the cutter *l*, may be properly adjusted in relation to the rod *x*, I fit the slide *m* with a nib *m*⁸, which bears against the cam *n* and is adjustably held in lugs or ears *m*⁹, by means of a nut *m*¹⁰ located between such lugs *m*⁹ and acting on a screw thread formed on the stem of the nib *m*⁸. The metal rod *x* is fed forward against a movable or disengaging stop *o*, which is adjustably screwed in the outer end of a slide *o*^{*}. This slide is mounted in guides *m*¹¹, *m*¹², and is acted upon by a cam *p* and spring *o'*, the said cam acting to advance it into position in front of the rod *x* to regulate the distance to which the said rod is advanced, and, when such rod has been advanced and then gripped by the chuck, the spring *o'*, by keeping the rear end of the stop slide *o*^{*} against the cam *p*, will cause such stop to retire out of contact with the end of the rod *x*. The cams are mounted on a shaft *q*, which is parallel with the hollow driving spindle *c*, and receives motion therefrom preferably by a cross shaft *r*, which is driven by a worm *s* on the hollow driving spindle *c* taking into a worm wheel *r'* on one end of the cross shaft *r*, the other end of which is provided with a worm *r*², which takes into a worm wheel *q'* fixed on the cam shaft *q*.

The balls, when cut off from the bar *x*, fall into the trough *t*, whence they are conducted to the receptacle by a channel *t'* in the slide *m*.

I will now describe the modifications represented at Fig. 21. In this case the hollow driving spindle *c* is a fixture endwise and the hollow chuck spindle *d* is movable, the same being forced normally backward by the spring *d*⁴, which is located between the rear end of the hollow driving spindle *c* and the thrust

collar *d*³ on the hollow chuck spindle *d*. The lever *f* is also reversed in position as compared with the arrangement described with respect to Figs. 1 to 20, in order that it may act at the required times to press the hollow chuck spindle *d* forward, in lieu of acting to press the hollow driving spindle *c* backward. Also, instead of, as in the arrangement described with respect to Figs. 1 to 20, placing the bearing balls *c*⁶ between loose collars *c*³, *c*⁵, on a tube forming a continuation of the hollow driving spindle *c* and retaining the loose collar *c*³ in position thereon by screw collars *c*⁴, the bearing balls *c*⁶ are in this latter arrangement placed between loose collars *c*³, *c*⁵, at the rear end of a tube *d*⁶ fixed to the rear end of the hollow chuck spindle *d*, such collars and bearing balls being inclosed within a cap *d*⁷ fitting over the end of the tube *d*⁶. In this case also the lever *f* acts upon the said cap *d*⁷ instead of on the loose collar *c*⁵, as in the arrangement described with respect to Figs. 1 to 20. In short the difference between the two arrangements herein shown and described is, that whereas in that described with respect to Figs. 1 to 20, and which is the form I prefer, the hollow driving spindle *c* is movable endwise and the hollow chuck spindle *d* is a fixture, the reverse is the case in that described with respect to Fig. 21, the connected and operating parts being suitably arranged for each case.

Having fully described my invention, what I desire to claim, and secure by Letters Patent, is:—

1. In machinery for turning metal balls or spheres, the combination of the head stock having the hollow rotating driving spindle coned out at its forward end, a hollow chuck spindle passed through the driving spindle and carrying a cone centering chuck whose jaws are held normally up in open position by an annular spring, a spiral spring between the end of the driving spindle and a collar on the chuck spindle for keeping the chuck normally closed onto the blank rod, the continuation of the hollow driving spindle, a collar secured thereon, anti-friction washers, balls between said washers, a pivoted lever engaging one of said anti-friction washers and moving the driving spindle longitudinally for releasing the chuck, means for opening said lever, a feeding mechanism and a cutting mechanism substantially as described.

2. In a machine for turning metal balls or spheres, the combination of the head stock having the hollow rotating driving spindle, a hollow chuck spindle passed through the driving spindle and carrying a chuck which is held in operative position by said driving spindle through the means of a spiral spring supported between the end of said driving spindle and a collar on the chuck spindle, a collar on the driving spindle, a pivoted lever *f* in engagement with said collar, the toggle levers *f*³ engaging the other end of said lever *f*, the slide *f'*, the cam *g*, suitable feeding

mechanism, and suitable cutting mechanism, substantially as set forth.

3. In machinery for turning metal balls or spheres, a head stock having a hollow driving spindle, a hollow chuck spindle within the driving spindle, an automatic gripping and releasing chuck on said chuck spindle, and a turning tool, in combination with an intermittent automatic sliding grip consisting essentially of a body portion *i* formed with an opening through it for the passage of the rod and perforated ears *i*² for supporting the gripping jaws, the gripping jaws *i*³ pivoted at their inner ends to the ears *i*² and adapted to engage the blank rod when moved forward, a spring for holding the gripping jaws in their disengaged position, and an operating lever engaging the outer ends of the gripping jaws and adapted to move them into engaged position against the action of the spring, substantially as set forth.

4. In machinery for turning metal balls, or spheres, a head stock having a hollow driving spindle, a hollow chuck spindle within the driving spindle, an automatic gripping and releasing chuck on said chuck spindle, and a turning tool or cutter in combination with a stop for limiting the forward movement of the blank, and an intermittent automatic feed consisting essentially of a sliding grip *i* adapted to engage the blank rod when moving forward, means for returning the grip, and a pivoted lever *j* operated by a cam *k* and having a forward spring arm *j*¹ engaging said grip, substantially as and for the purpose set forth.

5. In machinery for turning metal balls or spheres, a head stock having a hollow driving spindle, a hollow chuck spindle within the driving spindle, an automatic gripping and releasing chuck on said chuck spindle, and a turning tool or cutter, in combination with an intermittent automatic feed consisting essentially of a sliding chuck *i* provided with pivoted jaws *i*³, and an arm *i*⁴ pivoted to said jaws, a lever *j* engaging said arm *i*⁴, a cam operating said lever *j* and a spring for holding said chuck *i* in retracted position, substantially as set forth.

6. In machinery for turning metal balls or spheres, a head stock having a hollow driving spindle, a hollow chuck spindle within the driving spindle, an automatic gripping and releasing chuck on said chuck spindle, and a turning tool or cutter in combination

with an automatic intermittent feed, and a movable or disengaging stop for regulating the feed of the blank metal rod, and a cam and spring adapted to place said stop in front of the blank rod during the feed and to cause it to retire out of the way during the turning operation, substantially as set forth.

7. In machinery for turning metal balls or spheres, a head stock having a hollow driving spindle, a hollow chuck spindle within the driving spindle, and an automatic gripping and releasing chuck on said chuck spindle, in combination with a transversely supported cutting tool formed with an approximately semi-circular concave cutting edge having its outer or forward corner extending up to or a little beyond the horizontal center of rotation of the machine, and its inner corner a little short of said horizontal axis of rotation substantially as and for the purpose herein set forth.

8. In machinery employed in the turning of metal balls or spheres, a head-stock, having a hollow rotating driving spindle coned out at the front end, a hollow chuck spindle passed through the driving spindle and fitted with a coned centering chuck, a spring acting between the end of the driving spindle and a collar on the chuck spindle, to keep the chuck normally in its closed position, in combination with a cam operated lever acting upon one of such spindles to move it endwise and so release the chuck, loose disks at the rear end of such spindle, bearing balls between such disks, a grip feeder to feed the blank metal rod forward through the chuck spindle, a spring for keeping such feeder normally free of the blank metal rod, a cam for causing such feeder to grip and feed the blank metal rod forward at the required times, a slide carrying the turning tool or cutter, a cam and weight to give the required to and fro motion to such slide, a movable or disengaging stop for regulating the feed of the blank metal rod, and a cam and spring to place such stop in front of the blank rod during the feed, and to cause it to retire out of the way during the turning operation, substantially as herein shown and described.

GEORGE TAYLOR.

Witnesses:

WILLIAM EDWARD WARD,
3 Gordon Terrace, Cope St., Coventry.
WALTER JAMES HAYWOOD,
Stony Stanton Road, Coventry.